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INTRODUCTION

The IHKA system is a fully automatic climate control system. The acronym IHKA is derived from the German words **Integrierte Heizungs- und Klima-Anlage**, which translates to “integrated heating and air conditioning system.”

Interior heating and air conditioning (climate control) components and functions, separate on some earlier BMW systems, are integrated and work together to provide passenger comfort, regardless of ambient conditions. On IHKA systems, interior air discharge temperature is regulated by controlling the flow of hot engine coolant through the climate control system heater cores.

IHKA is classified as a fully automatic system because air distribution, air temperature and blower speed can be controlled automatically by the system control module.

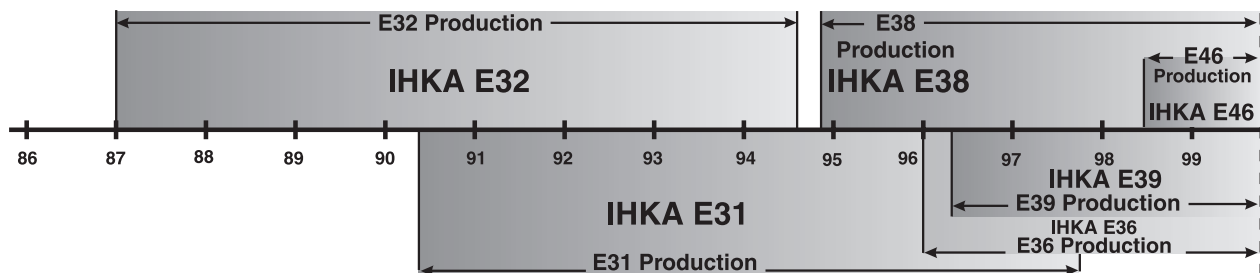
IHKA systems also feature some “set and forget” automatic functions which serve to maintain interior comfort without any input from the vehicle occupants.

IHKA first appeared in the U.S. on 1988 E32 (7-series) vehicles. E31 (8-series) vehicles, introduced three years later, use an IHKA system very similar to the E32 system.

An updated version of IHKA is installed on E38 (7-series) vehicles, beginning with the 1995 model year. The E36 (3-series), received IHKA in 1996, a system similar to the E38 system. The E39 (5-series) and E46 (3 series) have varied versions of IHKA

This course covers the following IHKA systems:

- IHKA E 31, 1991 - 8/97
- IHKA E38, 1995 - present
- IHKA E36, 1996 - present
- IHKA E39 1997 - present
- IHKA E46 1999 - present



IHKA Production Periods

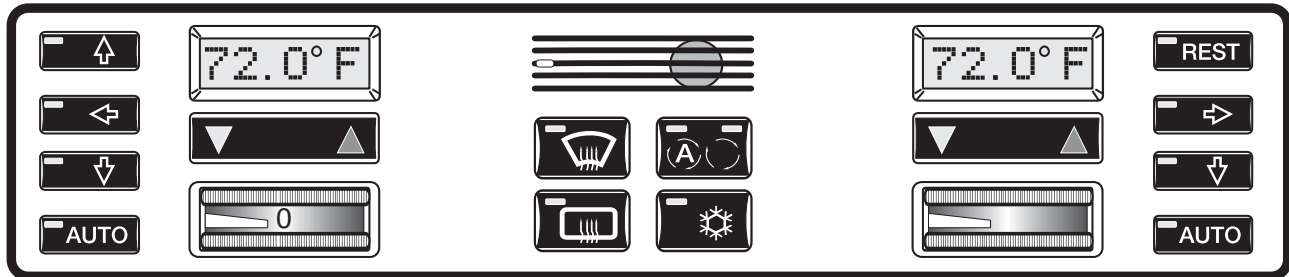
IHKA E38

The E38 IHKA system is a further development of the IHKA climate control system, but is very different from earlier IHKA systems in both construction and operation.

Important E38 differences (covered in detail later in this Handout) are listed below:

- The control module is integrated into the control panel.
- The blower speed control final stage unit is mounted on the blower motor assembly.
- The control panel/module has separate blower speed thumbwheels for the driver and passenger to regulate airflow separately on the left and right sides of the cabin.
- Face, footwell, and defroster vents can be opened individually or in combinations, using the separate “arrow” buttons on the control panel/module face.
- Left and right desired temperatures are changed using control panel rocker switches.
- Left and right desired temperatures appear in digital LED displays on the control panel face.
- Two additional temperature sensors are used, one at the left side and one at the right side of the center face vent outlet.
- Stratified air is available from the console rear outlet, and controlled by a thumbwheel at that outlet.
- Flap stepper motors are “smart”motors; each contains a microprocessor.
- The microfilter assemblies are integrated into the vehicle hood.
- The recirculating air function can be activated using a button on the steering wheel.
- A new function, automatic recirculating air (AUC), is activated automatically when poor ambient air **quality** is sensed.
- The control panel/module face includes a “REST” button for this new function, which uses the IHKA system to heat the passenger compartment for a short period after the ignition is switched “Off.”
- The windshield base heater present on early E32 vehicles is again available.

IHKA E38 CONTROL PANEL/MODULE (up to 5/96 production)



Functionally, the most significant difference between the IHKA E38 control panel and earlier IHKA control panels is that, **on E38 vehicles, the control panel is combined with the control module.** Despite this fact, the IHKA E38 control panel/module is about the same size as earlier control panels, and it has only three connectors.

The control panel/module face is also quite different from previous IHKA control panels. Features are described below, from left to right:

Air Distribution Buttons: There are four left (and three right) air distribution buttons. The driver can let the control module determine air distribution (automatic mode), or select up to three specific discharge locations (windshield, face vents, and/or footwells). The front passenger can also select automatic mode, or choose footwells and/or face vents.



If the “up arrow” button is pressed, air flows from the windshield defroster outlets all along the base of the windshield. The face vent, footwell and console outlets are closed, and the mixing flaps move to the “warmest air” position.



If the “left arrow” (or “right arrow”) button is pressed, air flows from the face-vent outlets on the left (or right) side of the instrument panel and the footwell outlets on that side of the interior close.

Only the “left arrow” button affects defroster and console flap operation. If the “left arrow” button is pressed, the defroster and footwell outlets are closed. The console flap opens so long as the rear outlet thumbwheel indicates “open.”



If the left (or right) “down arrow” button is pressed, air flows from the footwell outlets under the the left (or right) side of the instrument panel and the rear seat outlets on that side, too. The mixing flap for the left (or right) side of the interior moves to the “warmest air” position.

Only the left “down arrow” button affects defroster and console flap operation. If the left “down arrow” button is pressed, the defroster flaps are closed. The console flap opens so long as the rear outlet thumbwheel indicates “open.”



While there is an “AUTO” button for each side of the interior, the right button does not influence air intake location (fresh/recirc.), defroster flap operation, or console flap operation.

The basic function of the left and right “AUTO” buttons is, however, the same. When “AUTO” is pressed, the control panel/module selects the air distribution points based on the desired temperature, interior temperature, ambient temperature, (all “Y-factor” inputs) and blower speed.

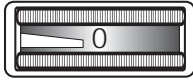
When cooling is required, the face vent flaps are opened and the footwell flaps are closed; when heating is required, the footwell flaps are opened and the face vent flaps are closed.



Left and Right Desired Temperature Displays: When the IHKA system is turned “On,” the left and right LED displays show the desired temperatures. LED brightness varies according to ambient light conditions.



Left and Right Desired Temperature Rocker Switches: Desired temperatures are selected using rocker switches. Pressing the blue “down” arrow decreases the desired temperature by 1°F (or 1/2°C) each time the button is pushed. Pressing the red “up” arrow increases the desired temperature. Large changes can be made by pressing and holding the “down” or “up” arrow.



Left and Right Blower Thumbwheels: There are separate blower control thumbwheels for the left and right sides. The control panel/module uses inputs from both to determine blower speed and face vent flap position.

The left blower thumbwheel is referred to as the master controller since:

- it has priority over other inputs when it is in the “0” and maximum-speed positions
- it is also used to turn the IHKA E38 system “Off” and “On”



Interior Temperature Sensor: Interior air is sampled using a temperature sensor located inside the control panel. Air reaches the sensor through an opening in the control panel face. Like other IHKA systems, IHKA E38 also uses a small electric fan to pull air over the temperature sensor.



Panel Illumination Photocell: A small photocell, located to the left of the interior temperature sensor, monitors ambient light levels. The control panel/module adjusts the brightness of the desired temperature displays using this input.



Maximum Defrosting Button: The maximum defrosting button has priority over all other IHKA system functions. When the button is pressed:

- the fresh air flaps open fully **and**
- the recirculating air flaps close fully **and**
- the mixing flaps move to the “warmest air” positions **and**
- the defroster flaps open fully **and**
- all other air distribution flaps close fully **and**
- the blower motor runs at maximum speed

If engine coolant temperature (supplied over the K-Bus) is above 32°F (0°C):

- the auxiliary coolant pump is activated

Neither the rear window defroster nor the A/C compressor turn on automatically, but will operate if the appropriate button is pressed.

AUC/Recirculating Air Button: The recirculating air/AUC button controls air intake location. During normal operation, fresh air is drawn into the climate control system and heated or cooled.



Pressing the recirculating air/AUC button **once** activates the automatic recirculating air function and lights the left LED. An AUC sensor, located in the engine compartment, monitors the level of oxidizable gases in ambient air and notifies the control panel/module when these gases reach a specified level. When this occurs, the control panel/module **automatically**:

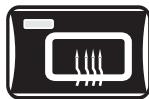
- closes the fresh air flaps **and**
- opens the recirculating air flaps

Refer to “IHKA E38 Special Functions” later in this Handout for more information on the AUC feature.

Pressing the recirculating air/AUC button **twice** causes the control module to light the right LED and immediately:



- close the fresh air flaps **and**
- open the recirculating air flaps



Rear Window Defroster Button: Pressing the rear window defroster button activates rear window heating at full power for either 17 or 10 minutes, depending on ambient temperature. The defroster is then shut off. Pressing the button again runs the defroster for another 5 minutes.



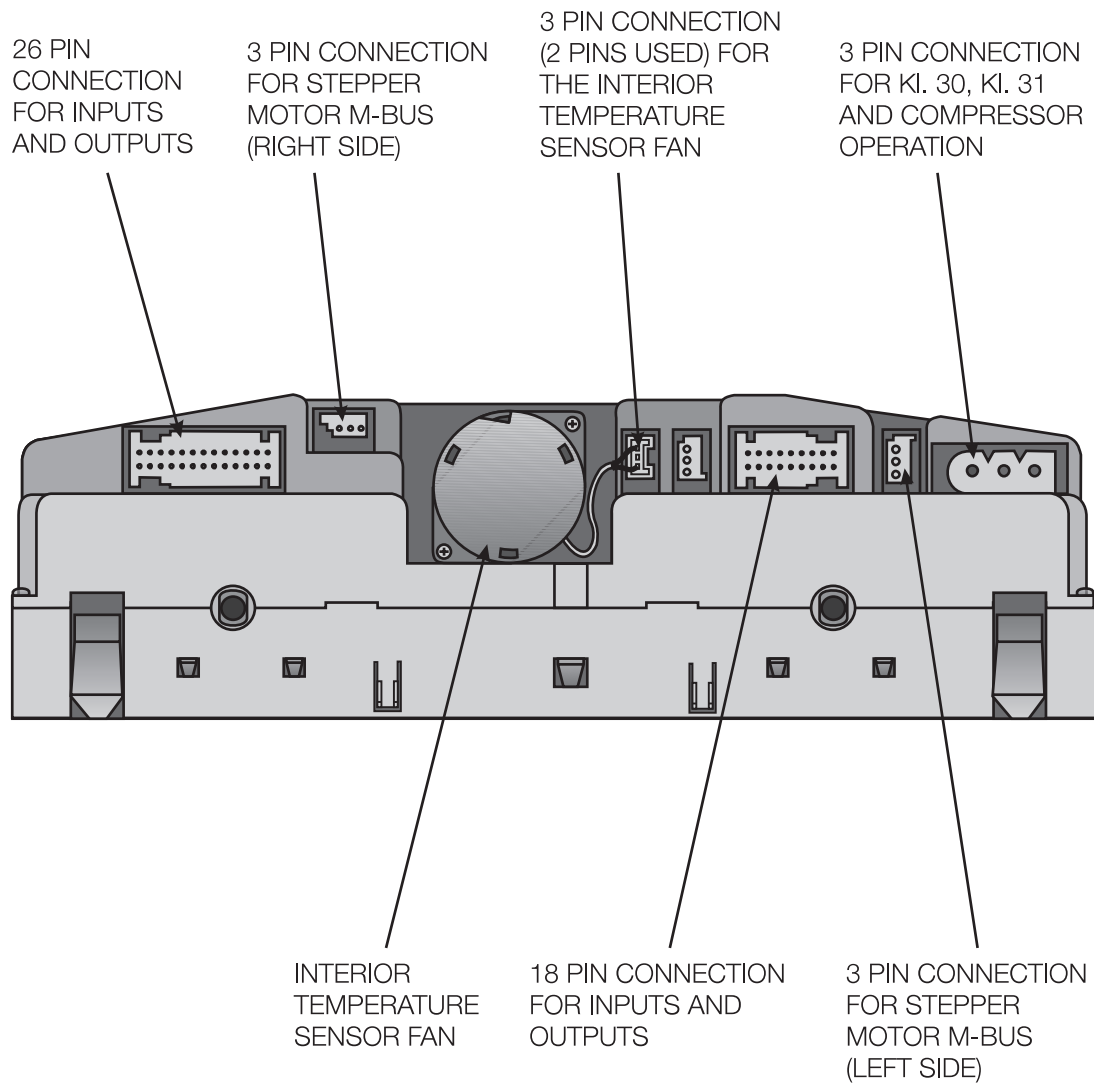
A/C Compressor Button: Pressing the “snowflake” button turns on the A/C compressor. The control panel/module activates the compressor directly, and interfaces with the engine control module for idle stabilization and auxiliary fan operation.



“Rest” Button: The “Rest” button is used to activate the rest heating function. This function provides passenger compartment heating after the ignition is switched “Off.”

Refer to “IHKA E38 Special Functions” later in this Handout for more information on the Rest function.

Viewed from the **bottom**, the IHKA E38 control panel/module has the following features:



Since the beginning of production, setting the temperature selector on the driver side of the IHKA to its minimum or maximum values would result in overriding the temperature setting on the passenger side. Both sides would either have heater off and maximum cooling with air conditioner on (min. value) or full heat (max. value), regardless of the setting selected on the passenger side.

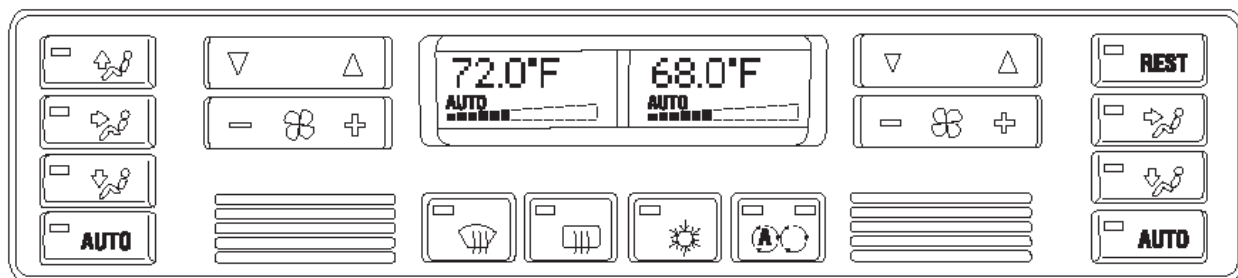
As of production date 9/95, the override function of the passenger side temperature settings will no longer be performed (IHKA control units with part numbers #64118369781 or #64118372482). Each side will work exactly according to its temperature setting, regardless of the temperature the other side has chosen.

Since the original IHKA control unit of vehicles produced before 9/95 is no longer available spare part for the IHKA control unit will also have this function change.

If replacement of an IHKA control unit becomes necessary on a vehicle which originally had the override function, the customer should be informed about this override function change in his car.

Due to changes made to IHKA control panels on 7 series (E38), the older style panels are no longer available. If replacement becomes necessary the new style panel must be retrofitted, and a customer has to be informed about new features of the unit.

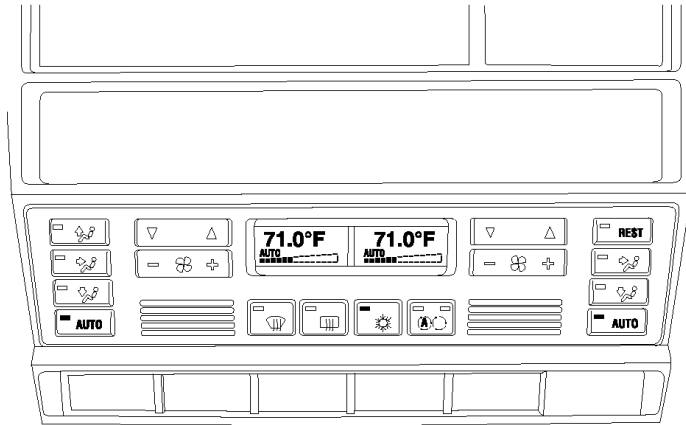
Changes to 7 Series (E38) IHKA control panel:



The IHKA control panel has changes in appearance and operation. The blower speed control wheels have been replaced by rocker switches. The push buttons for Front and Rear defrost, A/C control and AUC control are now mounted in a single row at the bottom center of the control panel

- after 9/96 production

The major changes in the operation of the system as of 9/96 are:

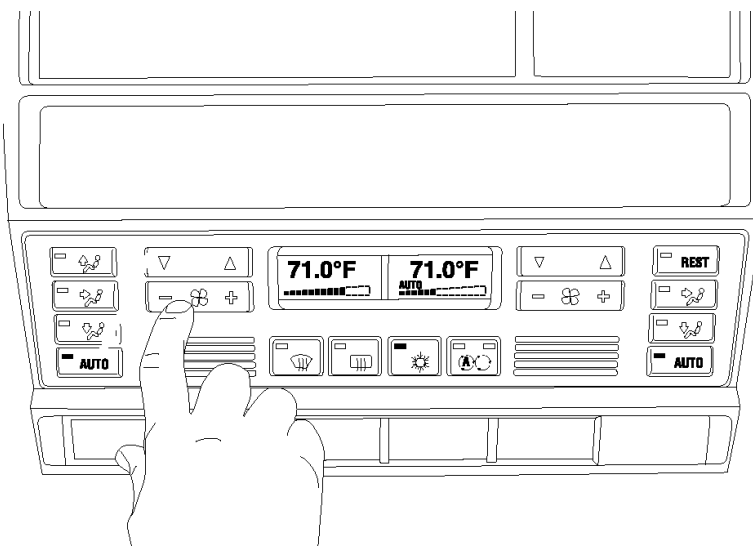


A new “AUTO-symbol” is used in the LCD display in addition to the illuminated LED on the “AUTO-button”.

- The “AUTO-symbol” in the LCD indicates the automatic fan speed program being activated.
- The illuminated LED on the “AUTO-button” indicates activation of the automatic air distribution program.
- When both are displayed, the system is in the fully automatic mode.

If one of the manual distribution buttons is selected, the automatic air distribution is cancelled and the “AUTO-button” LED goes out.

If one of the manual distribution buttons is selected, the automatic air distribution is canceled and the “AUTO-button” LED goes out (e.g. on the illustration - passenger face vent button was selected).



However, the fan speed remains in the auto mode, with “AUTO-symbol” being displayed on the LCD.

If the fan rocker switch is pressed, when the system is in the AUTO mode, the blower speed is switched to manual control. The “AUTO-symbol” in the LCD display goes out.

However, the air distribution remains in the automatic mode with the LED being illuminated on the “AUTO-button”.

IHKA E38 CONTROL PANEL/MODULE FUNCTIONS

The E38 control panel/module performs the same functions as the E31 control module. It controls:

- Blower speed
- Auxiliary coolant pump
- Auxiliary cooling fan
- Air intake flaps (fresh/recirculating)
- Air distribution flaps (face vent, foot-well, defroster, console rear outlet)
- Mixing flaps
- Heater core temperatures
- Evaporator temperature
- Special programmed functions
- Windshield base/washer spray jet heaters

In addition, it has an EEPROM to store fault codes. The EEPROM allows the module to “go to sleep” about 16 minutes after the ignition is switched to “Off,” to reduce power consumption without losing the contents of the memory.

Fault codes stored cannot be erased by disconnecting the battery; the DIS/MoDiC must be used. A maximum of six fault codes can be stored at one time.

NOTE: If the control module is replaced it must be coded.

SUBSTITUTE VALUE OPERATION

If an **input** potentiometer or sensor (or its circuit) fails, the control panel/module will ignore the faulty input and, in its place, use a replacement value which has been programmed into its memory for just this purpose. The replacement value, typically a mid-scale value for a particular input, allows the system to operate as normally as possible, despite the fault.

Substitute values for IHKA E38 components are:

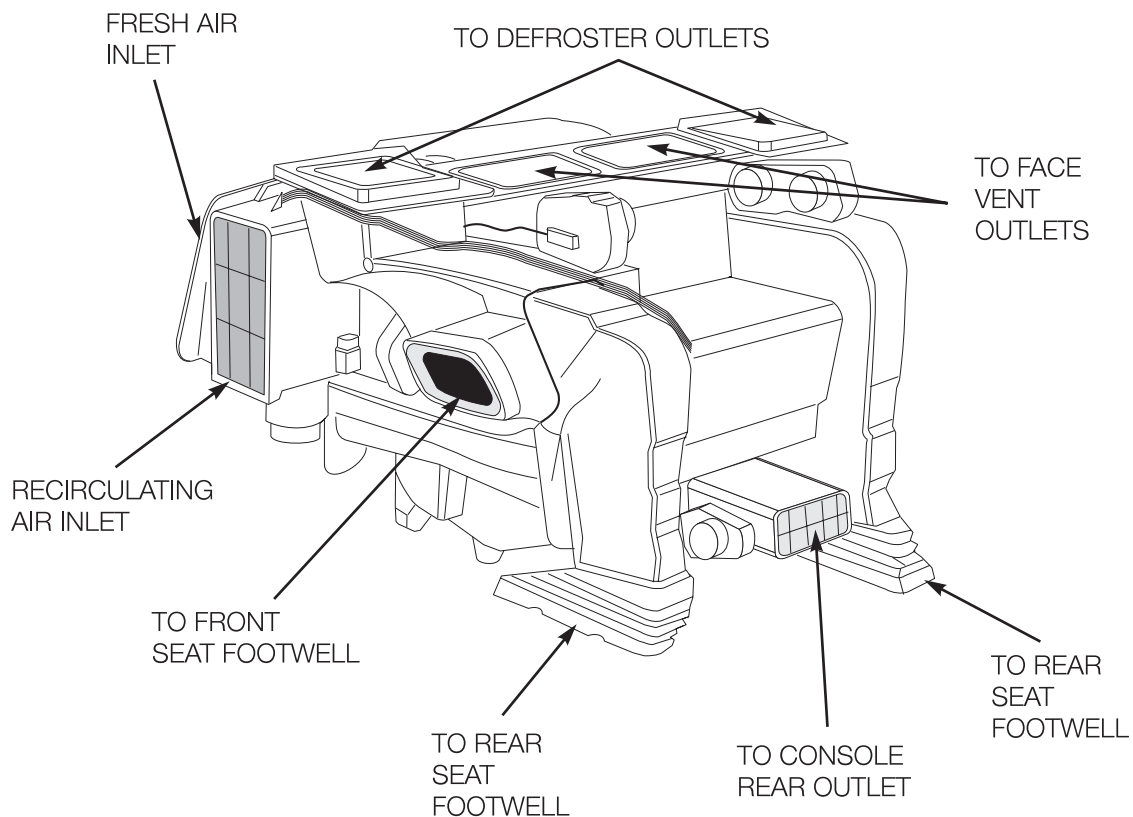
- Desired temperature value (left or right)75°F (24°C)
- Interior temperature sensor68°F (20°C)
- Face-vent temperature sensor (left or right)75°F (24°C)
- Heater core temperature sensor (left or right)130°F (55°C)
- Evaporator temperature sensor32°F (0°C)*
- Ambient temperature sensor32°F (0°C)**

* The substitute value for the evaporator temperature sensor is below the A/C compressor cycling point (1-3°C). Therefore, if the evaporator temperature sensor signal is not plausible, the substitute value will switch the A/C system off.

** The IHKA control panel/module obtains ambient temperature information over the K-Bus, not from a dedicated IHKA system sensor. If the value received is not plausible (not between -40°C and +80°C), the control panel/module will ignore the supplied value and use the substitute value instead.

IHKA E38 HOUSING ASSEMBLY

The IHKA E38 housing is very different in appearance and layout from earlier IHKA housing assemblies, but it has almost the same system components mounted inside or on it.



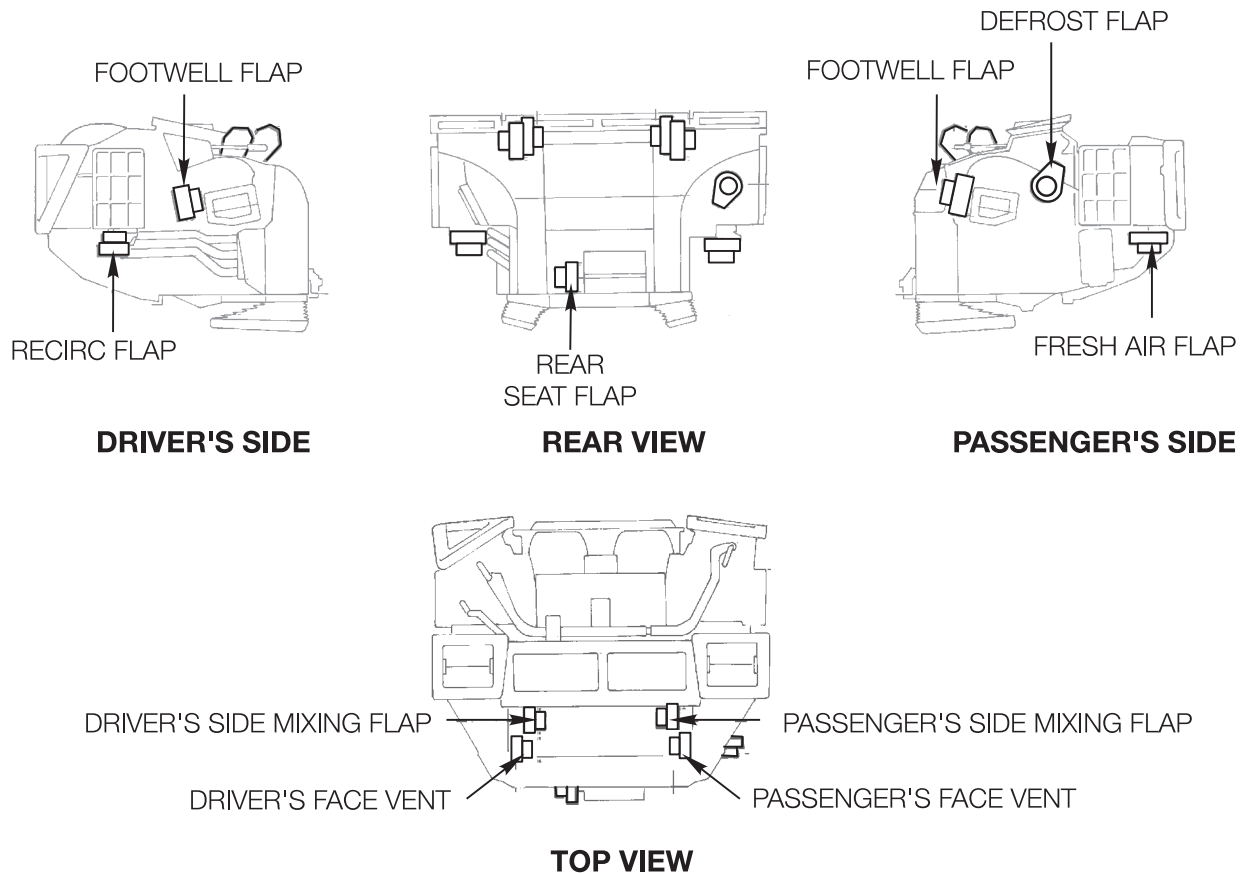
IHKA E38 Housing Assembly

Significant differences from earlier IHKA housing assemblies are:

- The housing assembly mounts against a vertical area of the engine compartment/ interior bulkhead, with no parts protruding through the bulkhead.
- The housing assembly does not contain the microfilter; the filter is incorporated into the hood-mounted air intake ducting.
- No ambient temperature sensor is mounted on the E38 housing. The control panel/module obtains ambient temperature from the instrument cluster via the K-bus.
- The system control module is not mounted on the housing; it is combined with the control panel.

IHKA E38 uses **ten stepper motors** to position the various flaps.

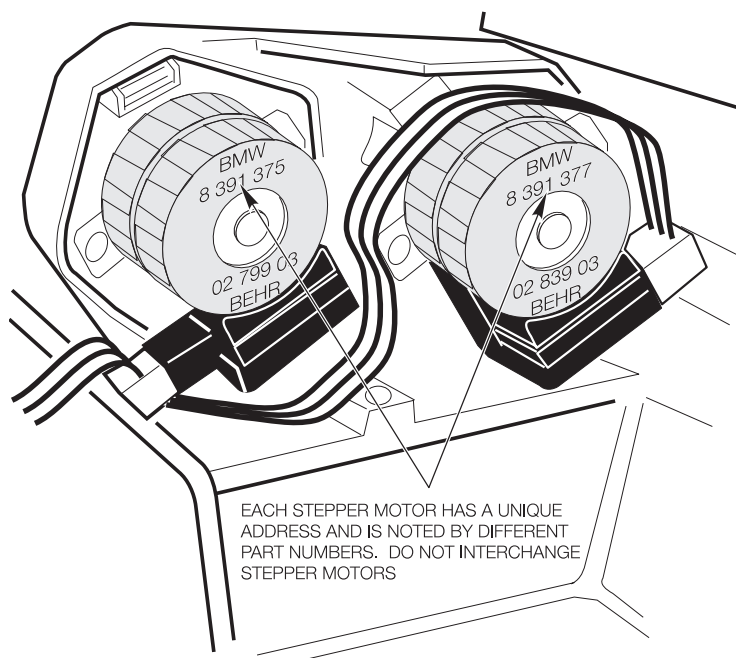
The stepper motors are mounted on the housing assembly as shown:



Only the fresh air flap stepper motor is a conventional stepper motor; it is linked to the control panel/module by four circuits.

The other nine stepper motors are "smart" motors; each one contains a microprocessor.

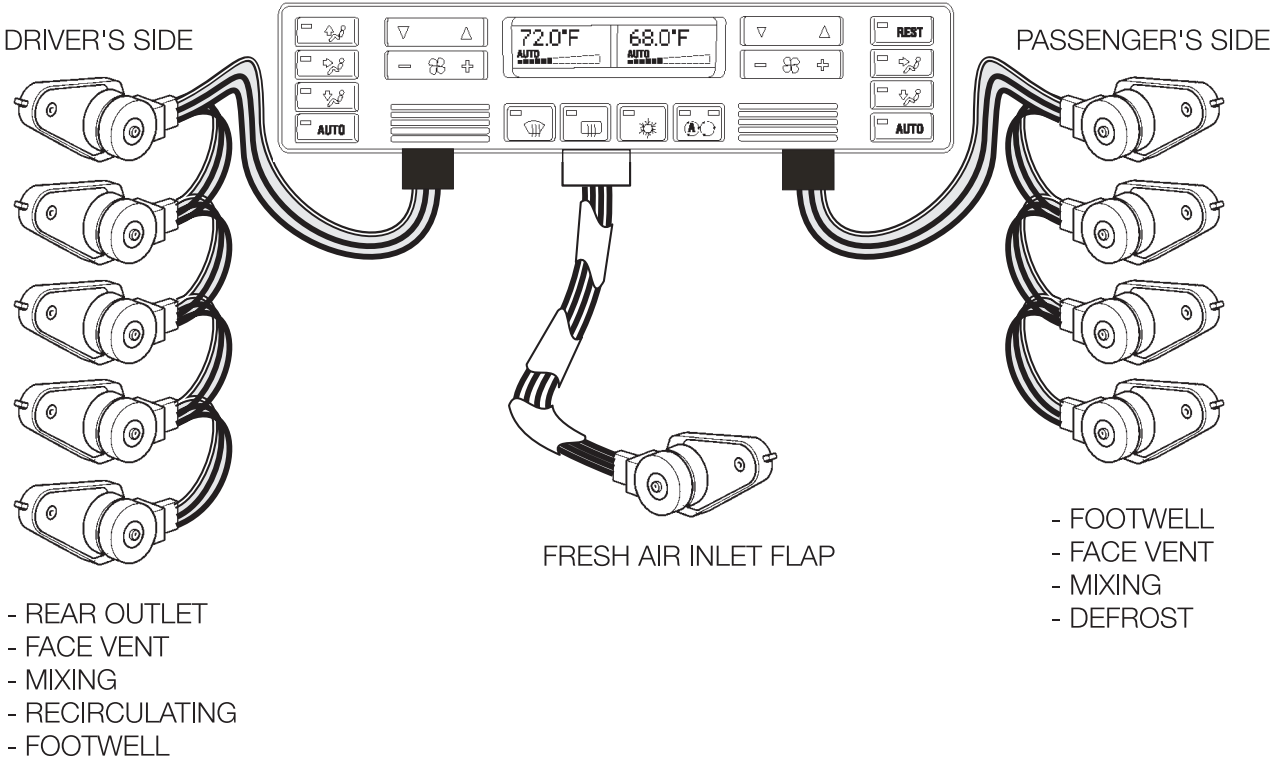
The smart stepper motor used at each position has a unique part number.



EACH STEPPER MOTOR HAS A UNIQUE ADDRESS AND IS NOTED BY DIFFERENT PART NUMBERS. DO NOT INTERCHANGE STEPPER MOTORS

All nine “smart” stepper motors share the same power, ground, and signal circuits (referred to as the M-Bus), but the circuits split into two paths at the control panel/module:

- The left side includes five motors and the connector is color-coded white.
- The right side includes four motors and is color-coded black.



IHKA E38 M-Bus

The microprocessor in each motor gives it an “identity.” When the control panel/module wants a specific motor to run, it “names” the motor it wants to respond and issues a command.

Since all the stepper motors share the same signal circuit, they all “hear” the command.

Each stepper motor processes the command and determines whether it should respond.

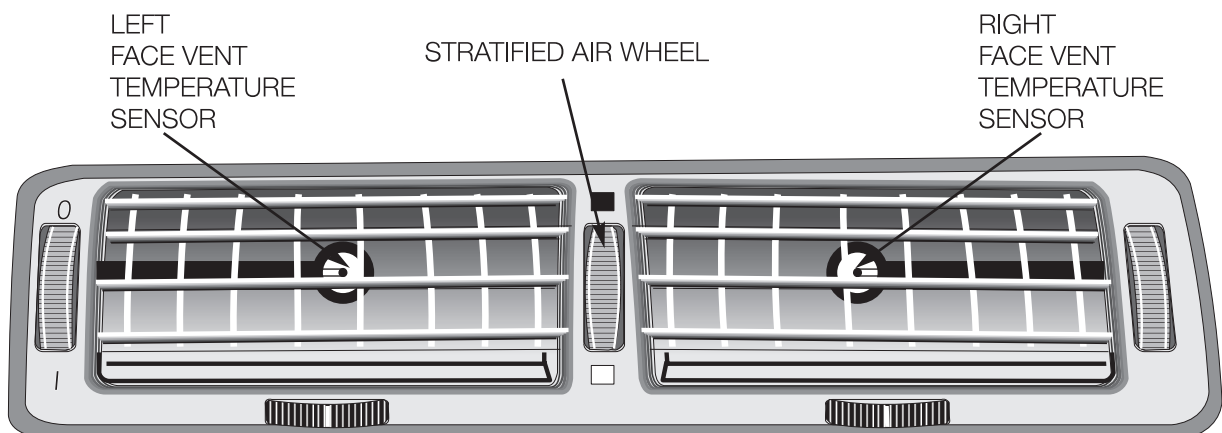
Only the stepper motor which “hears” its name follows the command.

IHKA E38 TEMPERATURE SENSING

The IHKA E38 control panel/module needs the same temperature inputs as earlier IHKA systems, but it does not get all of them from dedicated IHKA temperature sensors:

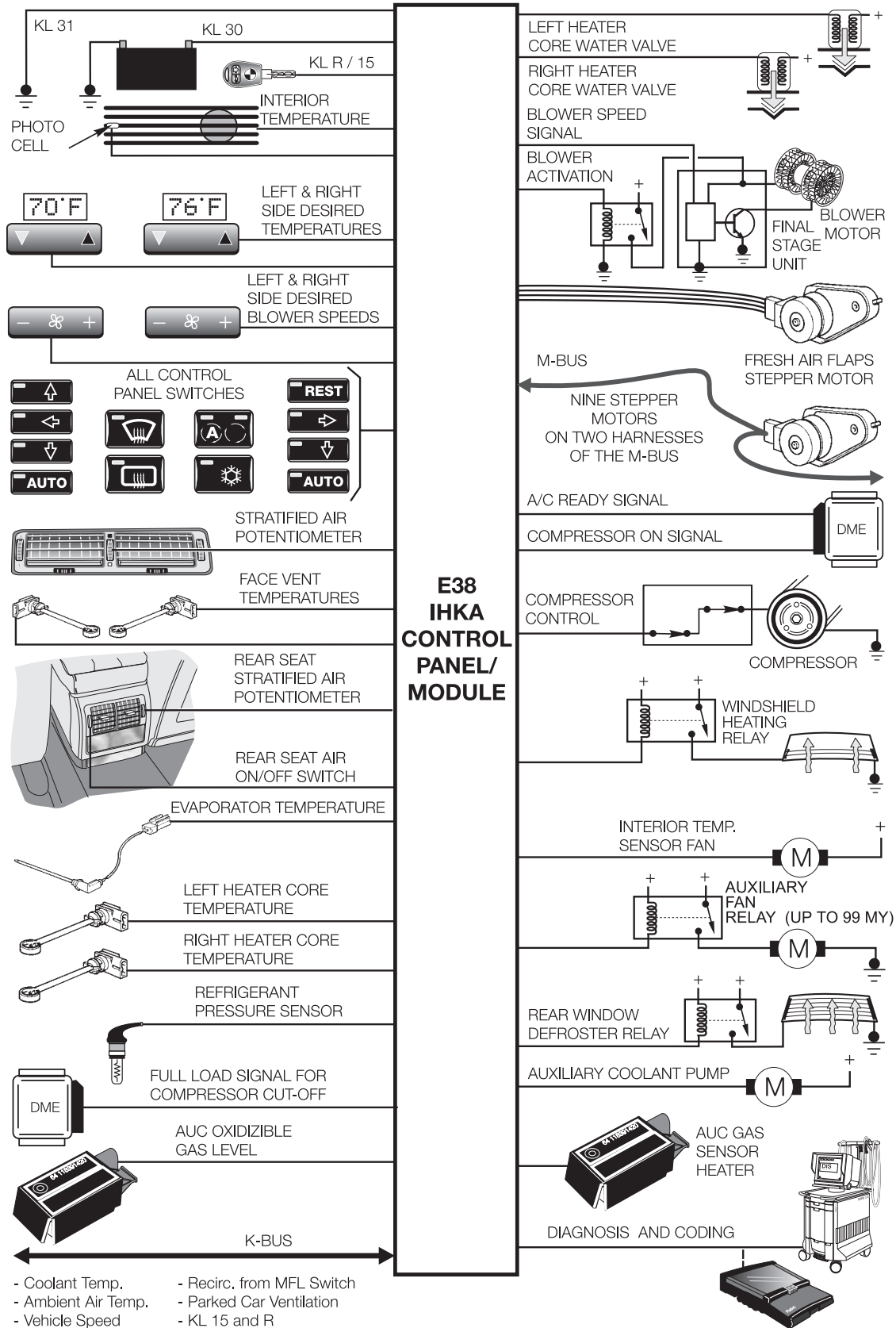
- **Ambient temperature** - this is **not** provided by a dedicated IHKA sensor. On the E38, the ambient temperature sensor is located in the left front brake cooling duct, and supplies its signal to the IKE. The IKE then supplies ambient temperature information to any control modules requiring it over the K-Bus.
- **Evaporator temperature** - this is provided by a dedicated IHKA sensor, inserted into the evaporator core through an opening on the left side of the housing assembly as on previous IHKA systems.
- **Heater core temperatures** - these are provided by dedicated IHKA sensors, located in the IHKA housing rear cover as on earlier systems. On E38, though, the sensors are inserted in openings on **top** of the cover and they hang down, behind the heater cores.
- **Interior temperature** - this is provided by a dedicated IHKA sensor, located inside the system control panel/module and, as on previous systems, it has a small fan motor.

The IHKA E38 system processes two **additional** temperature sensor inputs: left and right face vent temperatures. These are provided by face vent temperature sensors, located just behind the center face vent outlets.



The control panel/module uses the information they provide (along with left and right desired temperature settings and the temperature mixing thumbwheel input) to control the left and right mixing flaps.

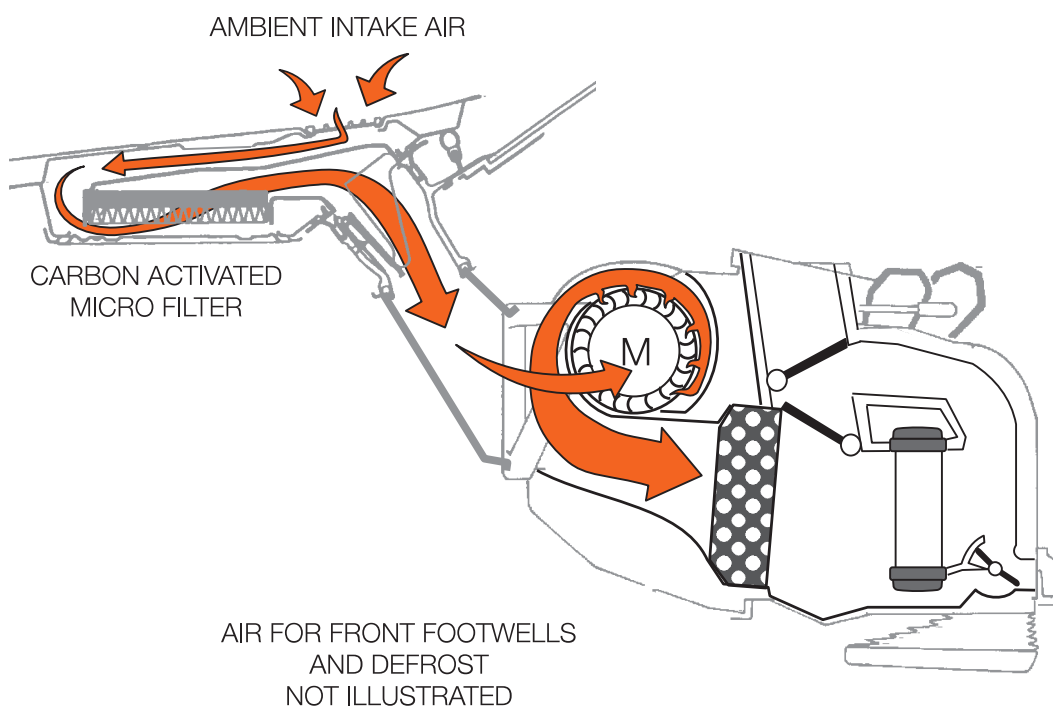
IHKA E38 IPO (as introduced)



IHKA E38 AIR INTAKE

As on E32 and E31 vehicles, the IHKA systems can take in fresh air, recirculate air already in the interior, or do both at the same time (recirc. flaps fully open/fresh air flaps 30% open).

Fresh air enters the IHKA E38 system through inlet grilles at the trailing edge of the hood. It flows downward and forward into a plenum which houses the activated-charcoal micro-filter. After flowing through the filter, the air flows rearward and downward into the housing through air intake ducts.

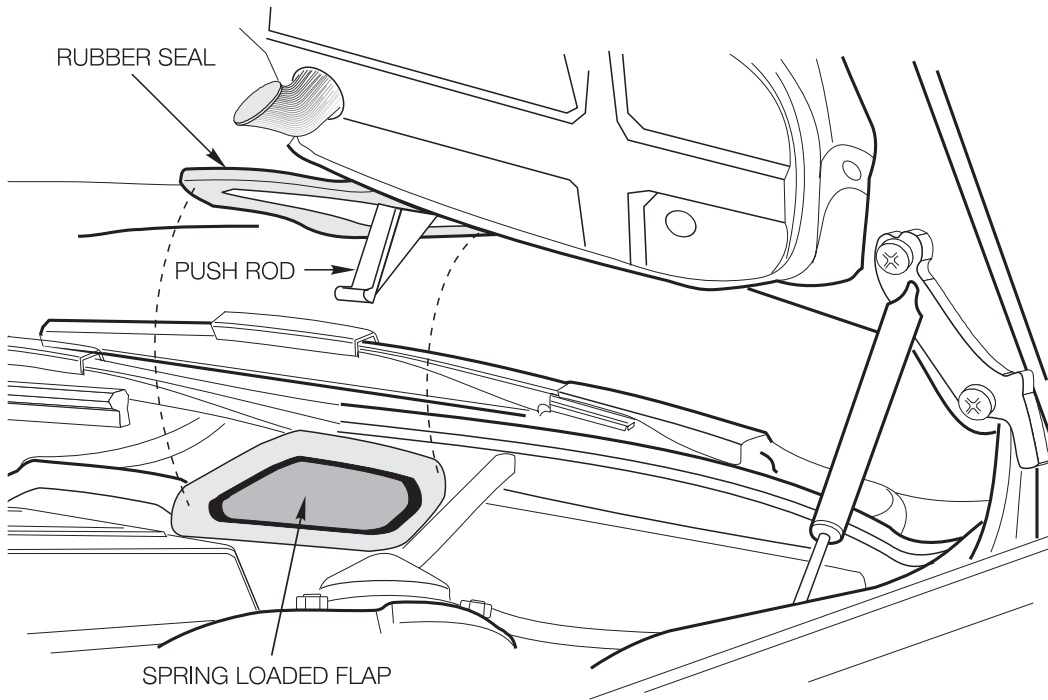


IHKA E38 Fresh Air Intake Path

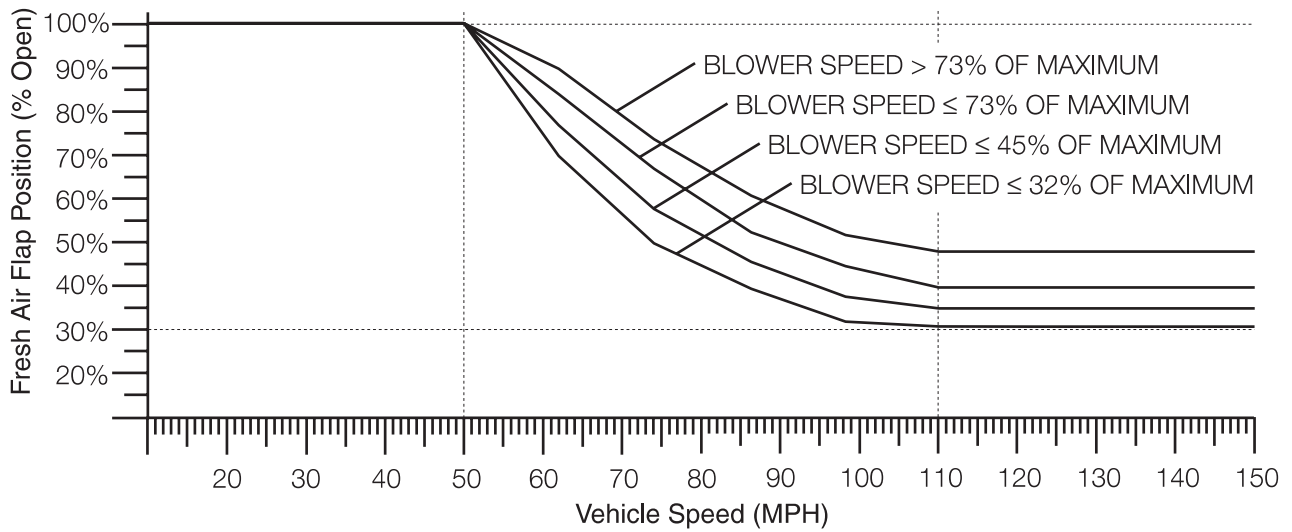
To prevent objects from falling into the fresh air intake ducts while the hood is open, a spring-loaded flap is placed at the entrance to each duct. As the hood is opened, the flaps close automatically. When the hood is closed, pushrods mounted to the underside of the hood force the flaps open.

Any water which enters the air intake ducts will flow to an area just ahead of the fresh air flaps. Rubber tubing then directs the water to the evaporator area of the housing, where it drains with any evaporator condensate.

NOTE: System operation should not be checked or evaluated while the hood is open.



As on previous IHKA systems, the fresh air flaps close with increasing vehicle speed to counteract the ram air effect. On E38 vehicles, however, blower speed also influences the amount the flaps close. At low blower speeds, the fresh air flap throttling effect is most pronounced (fresh air flap only 30% open at very high speeds). At higher blower speeds, however, the throttling effect is less significant.



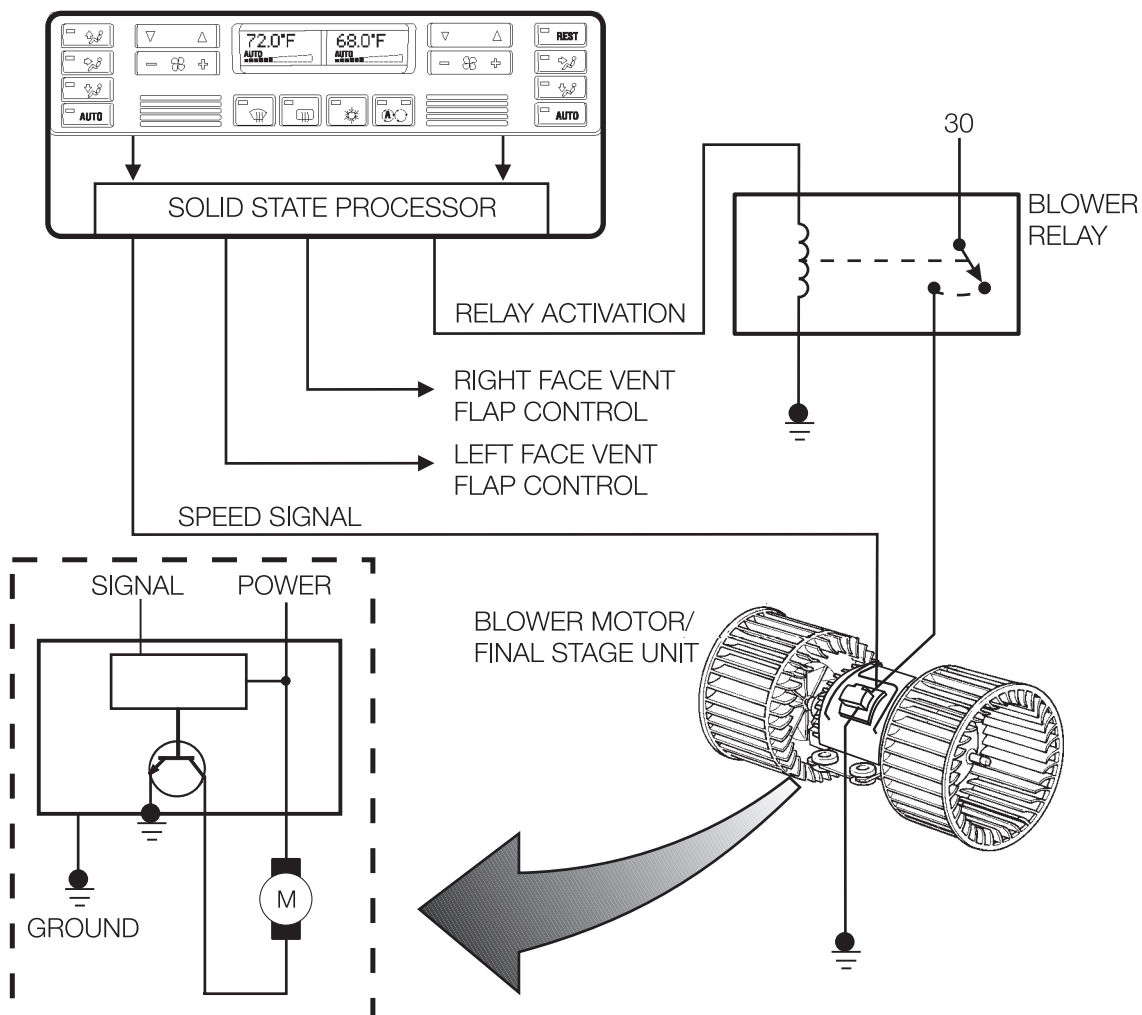
Vehicle Speed Influence on Fresh Air Flap Position

IHKA E38 BLOWER CONTROL

While the basic operating theory for E38 blower control is similar to that of earlier IHKA systems, the number of components involved and their appearance is quite different:

- The control panel and control module are combined into one unit.
- The final stage unit is mounted directly on the blower motor assembly.
- The control panel/module supplies the voltage to energize the blower relay.
- The control panel/module has separate blower speed thumbwheels for the driver and passenger.

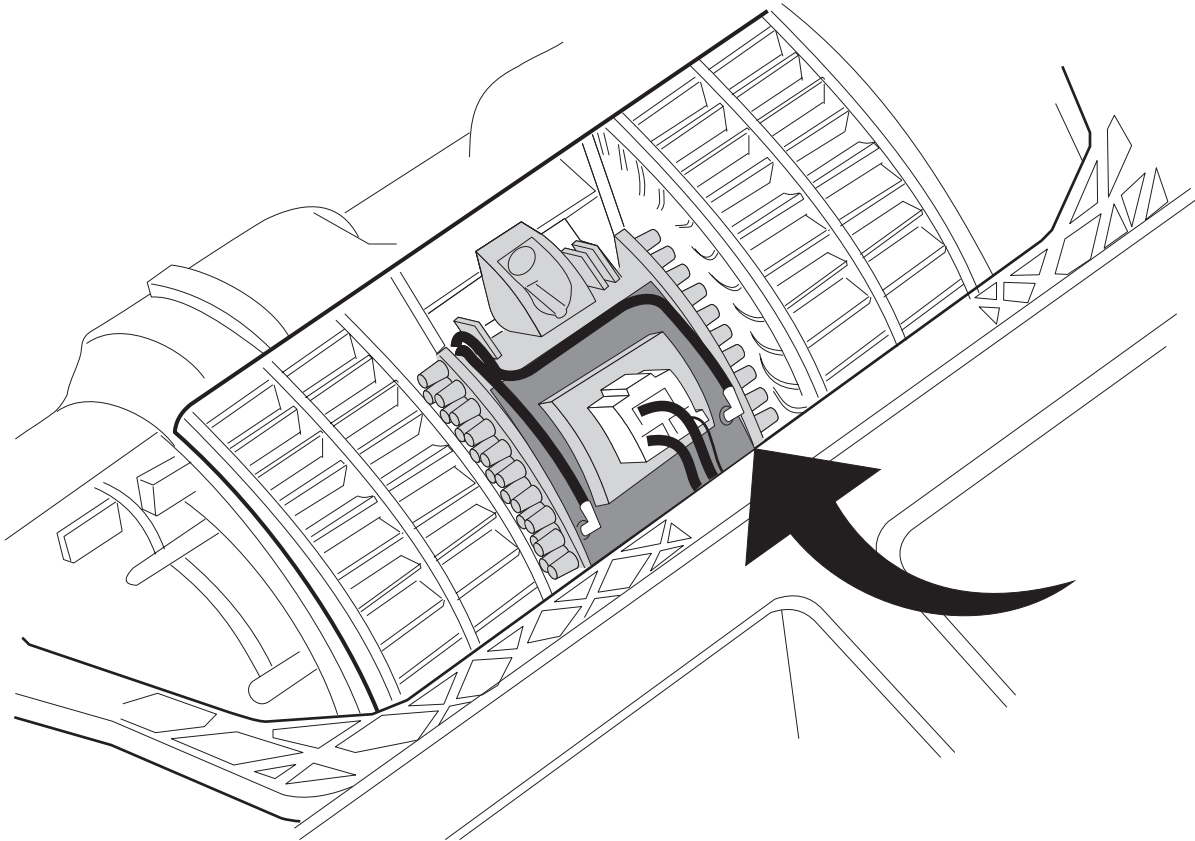
IHKA E38 CONTROL PANEL /MODULE



Each of the blower thumbwheels supplies a voltage signal to a processor inside the control panel/module. The processor always runs the blower motor at the **higher** selected speed to ensure adequate air flow on that side of the interior.

The processor also influences face vent flap position. To achieve reduced air flow on one side of the interior, the face vent flaps of that side are partially closed.

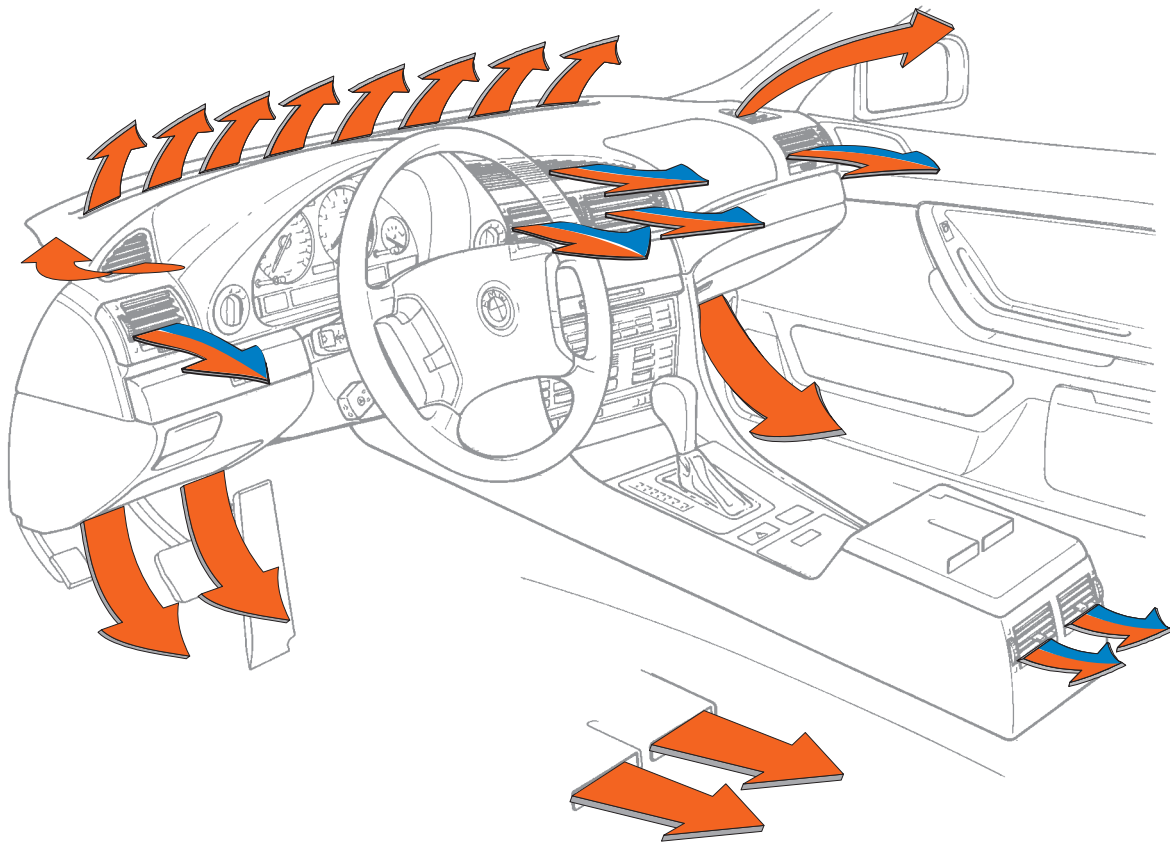
-
- The final stage unit is mounted directly on the blower motor assembly, between the dual impellers.



IHKA E38 Blower Motor/Final Stage Unit

- The E38 evaporator is coated with polyurethane, and has a plastic gauze-type screen placed against it's outlet side. These changes improve condensate drainage.

IHKA E38 AIR DISTRIBUTION



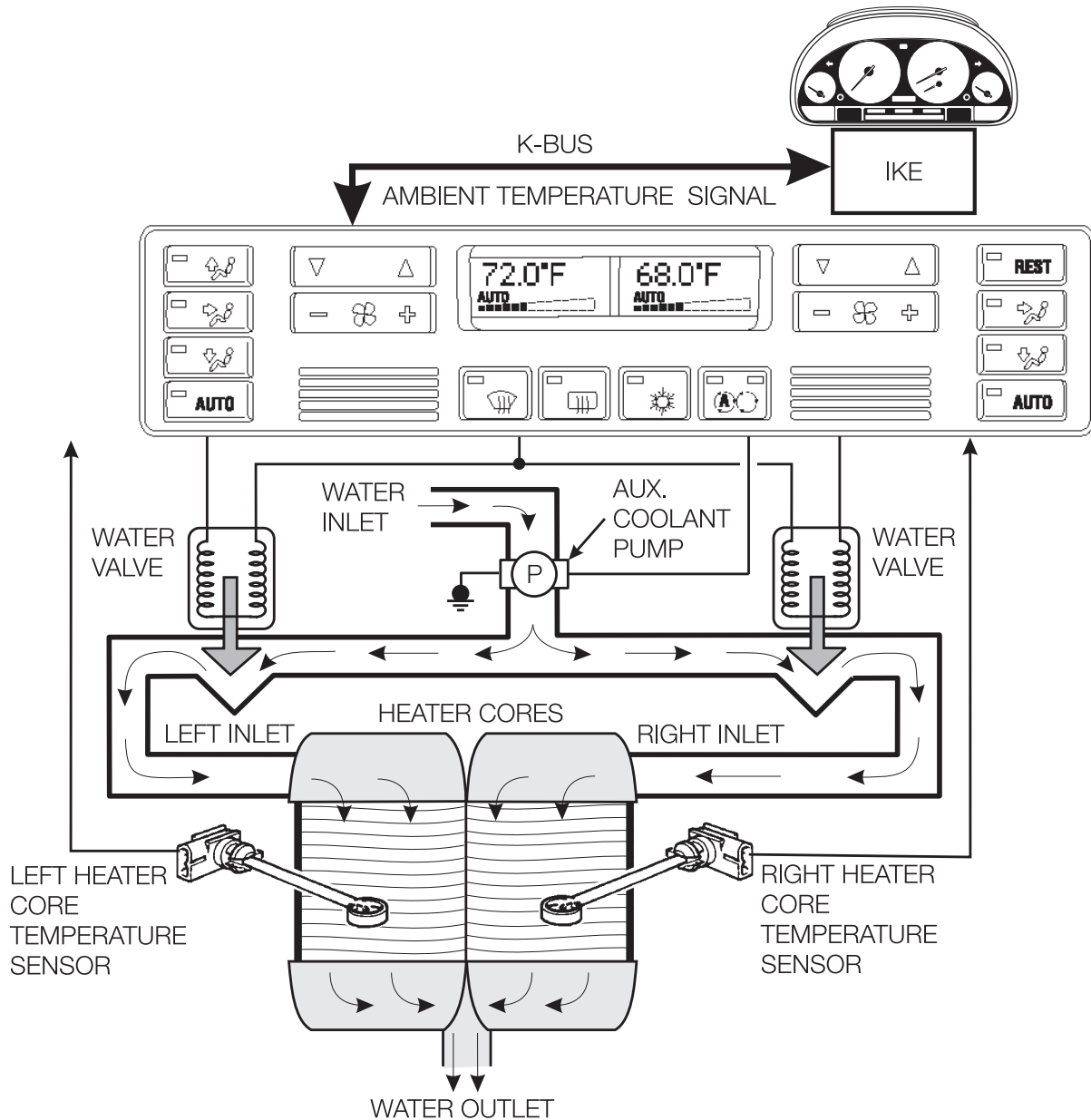
E38 Air Distribution Outlets

The locations of E38 air distribution outlets are shown above. While flap operation strategies are similar to those on E31 vehicles, there are some significant differences.

A new input helps determine face vent flap positions - blower speed request position:

- The IHKA E38 control panel/module has **separate blower request buttons for the driver and passenger**, yet has only one blower motor assembly. Since the blower cannot run at two speeds at once, it always runs at the **higher** requested speed. For the side requesting the lower blower speed, the control module/panel **partially closes** the face vent flap to reduce air flow on that side of the vehicle.
- For example, if the driver requests low blower speed and the passenger requests medium blower speed, the control panel/module will:
 - Run the blower at medium speed
 - Open the passenger side face vent flap fully
 - Nearly close the driver side face flap for low air flow

IHKA E38 TEMPERATURE REGULATION



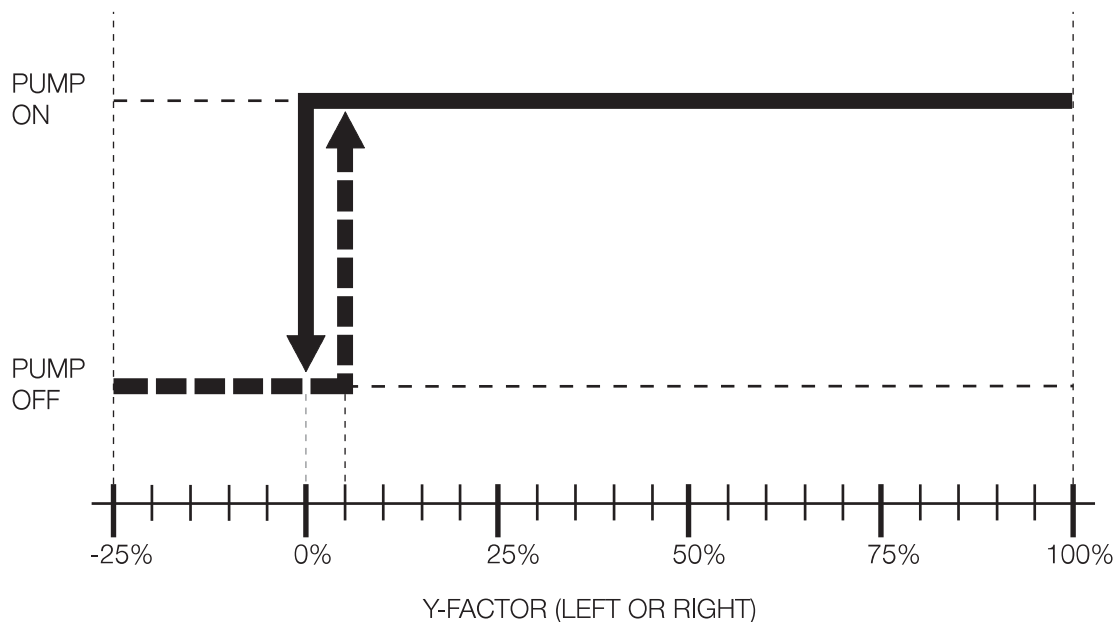
Temperature regulation on IHKA E38 is accomplished in exactly the same way as on earlier IHKA systems: solenoid actuated water valves, normally held open by spring pressure, are pulsed closed by the IHKA control panel/module to regulate coolant flow through the cores (and, thereby, the core temperatures).

The IHKA control panel/module pulses the water valves according to the following inputs:

- ambient temperature
- interior temperature
- left and right desired temperatures
- left and right heater core temperatures.

E38 vehicles also have an electrically powered auxiliary coolant pump to ensure that an adequate supply of hot water is always available to the heater cores. The control panel/module operates the pump directly (no relay), by supplying the ground circuit. Pump operating criteria are:

- Engine coolant temperature (ECT)* **and** Y-Factor -- **ON** with $ECT \geq 32^{\circ}F$ ($0^{\circ}C$) and left **or** right Y-Factor $\geq 5\%$; **OFF** with $ECT < 32^{\circ}F$ ($0^{\circ}C$) and either Y-Factor $< 0\%$, unless other inputs call for pump operation)
- Maximum defrost mode status -- **ON** when max. defrost is selected; **OFF** when max. defrost is turned off (unless other inputs call for pump operation)
- Maximum heating requested on left side of interior -- **ON** when max. heating is requested; **OFF** when max. heating is turned off (unless other inputs call for pump operation)
- “REST” function request -- **ON** when REST heating is requested; **OFF** when REST heating is turned off or “times out”



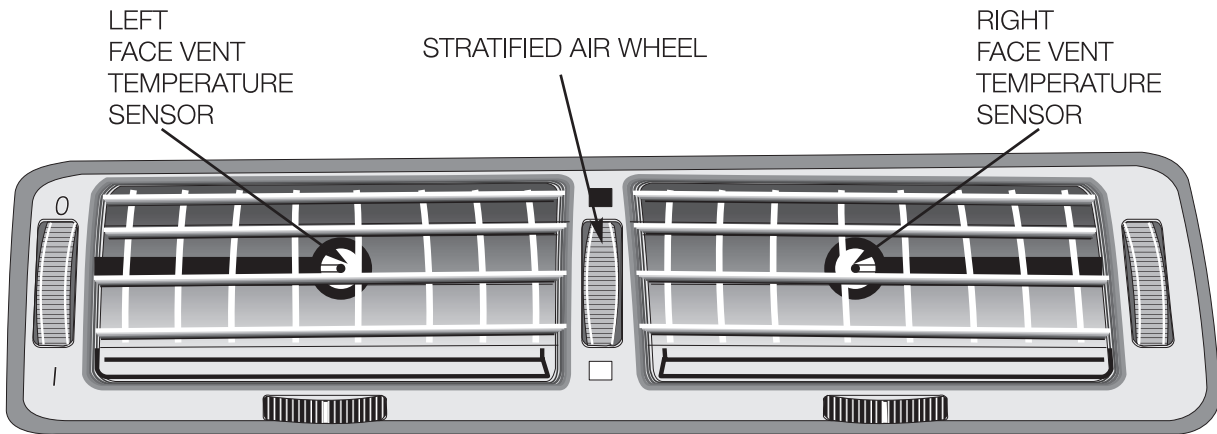
Y-Factor Influence on Auxiliary Coolant Pump Operation

* Engine coolant temperature information is supplied to the control panel/module over the K-Bus.

IHKA E38 TEMPERATURE MIXING

Temperature mixing on IHKA E38 is similar to that on E31, except:

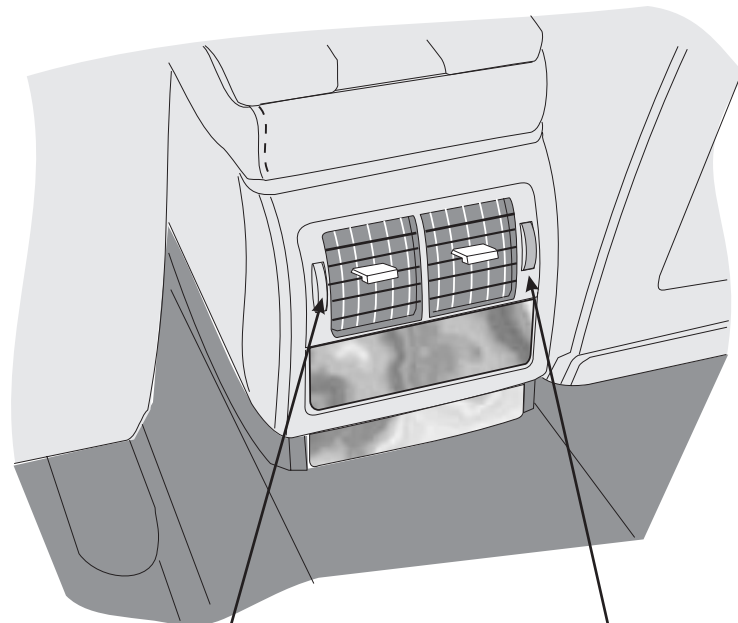
- The E38 mixing flaps have two layers, instead of three.
- There is a temperature sensor in each side of the center face vent outlet, so that air discharge temperature at this location can be better controlled.



E38 Center Face Vent

NOTE: The face vent mixing flaps always move to the “warmest air” position whenever the “up arrow” (defrost), “down arrow” (footwell), or maximum defrost mode buttons are pressed. They also move to the “warmest air” position when the system is turned “off.”

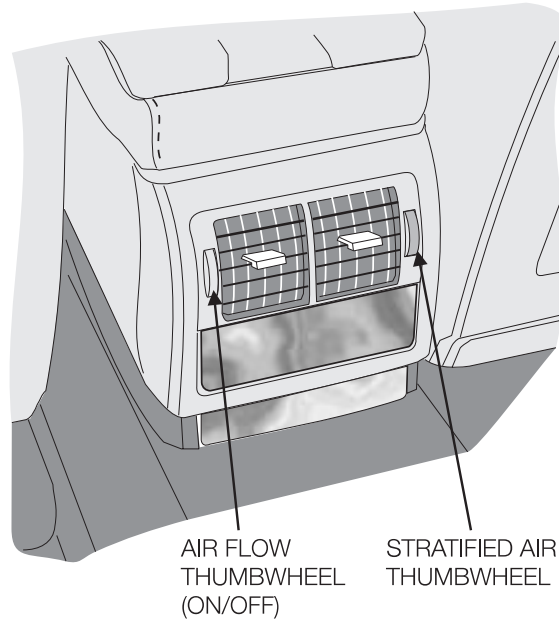
- For the first time on any IHKA system, stratified air is available from the console rear outlet.
- The thumbwheel to the left of the outlet operates an on/off switch for airflow control.
- An additional thumbwheel to the right of the outlet allows rear seat passengers to vary air discharge temperature as well.



AIR FLOW
THUMBWHEEL
(ON/OFF SWITCH)

STRATIFIED AIR
POTENTIOMETER
THUMBWHEEL

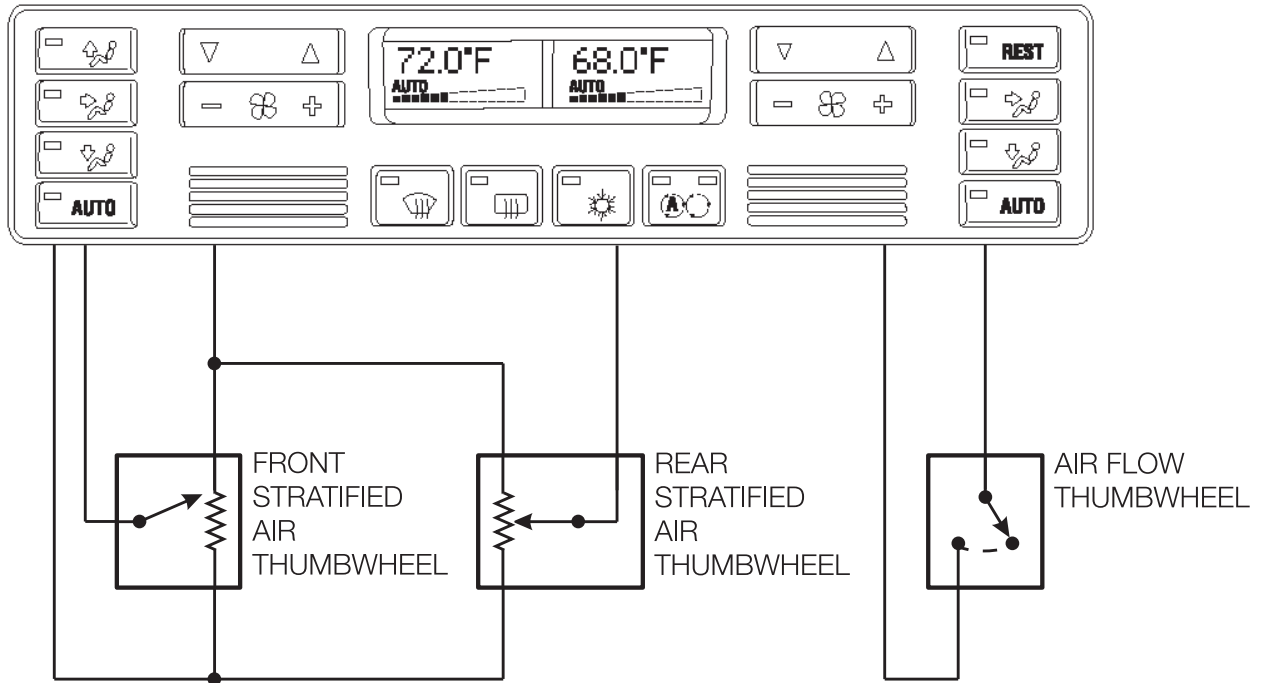
The console outlet is almost always open when the IHKA system is “on” and the rear seat passengers request air flow. An exception is during windshield defrosting (and maximum defrost mode) when the console outlet flap is fully closed.



The same flap and stepper motor, located on the IHKA E38 housing assembly, performs both the open/close and temperature control functions for the console outlet.

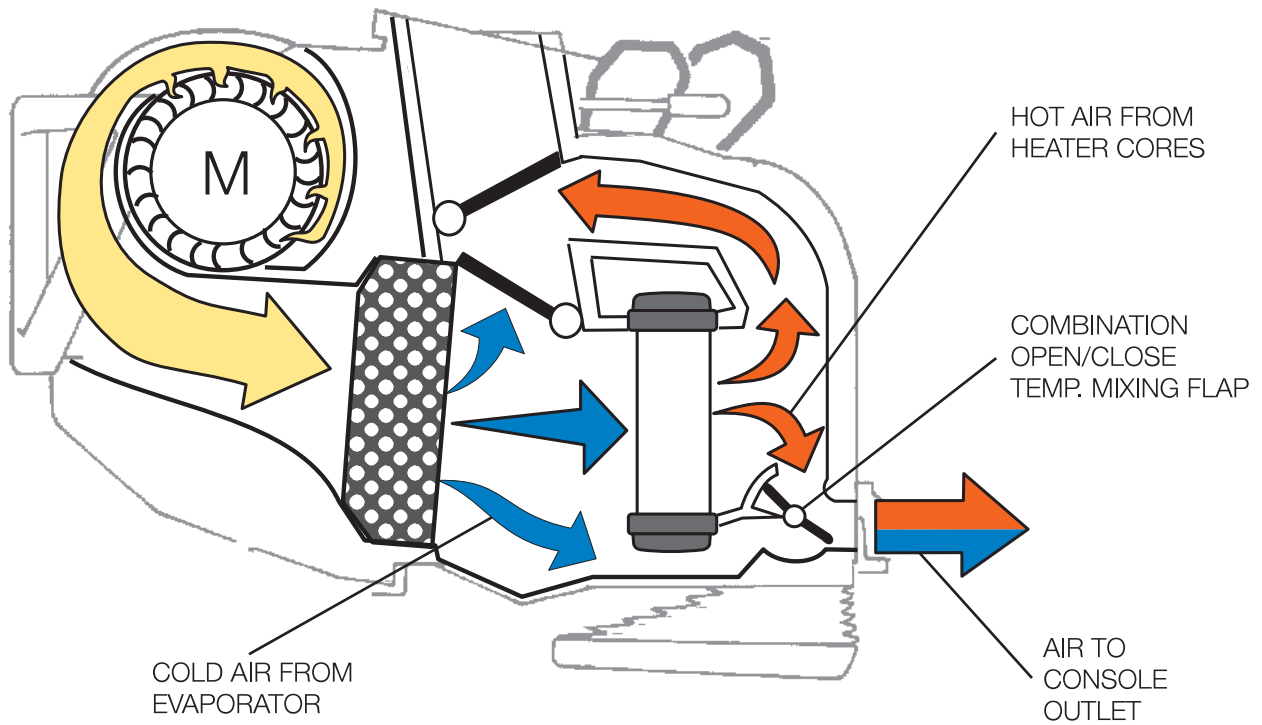
The stepper motor is operated by the control panel/module using information from the console rear outlet thumbwheels and the control panel/module buttons (left air distribution only).

IHKA E38 CONTROL PANEL /MODULE

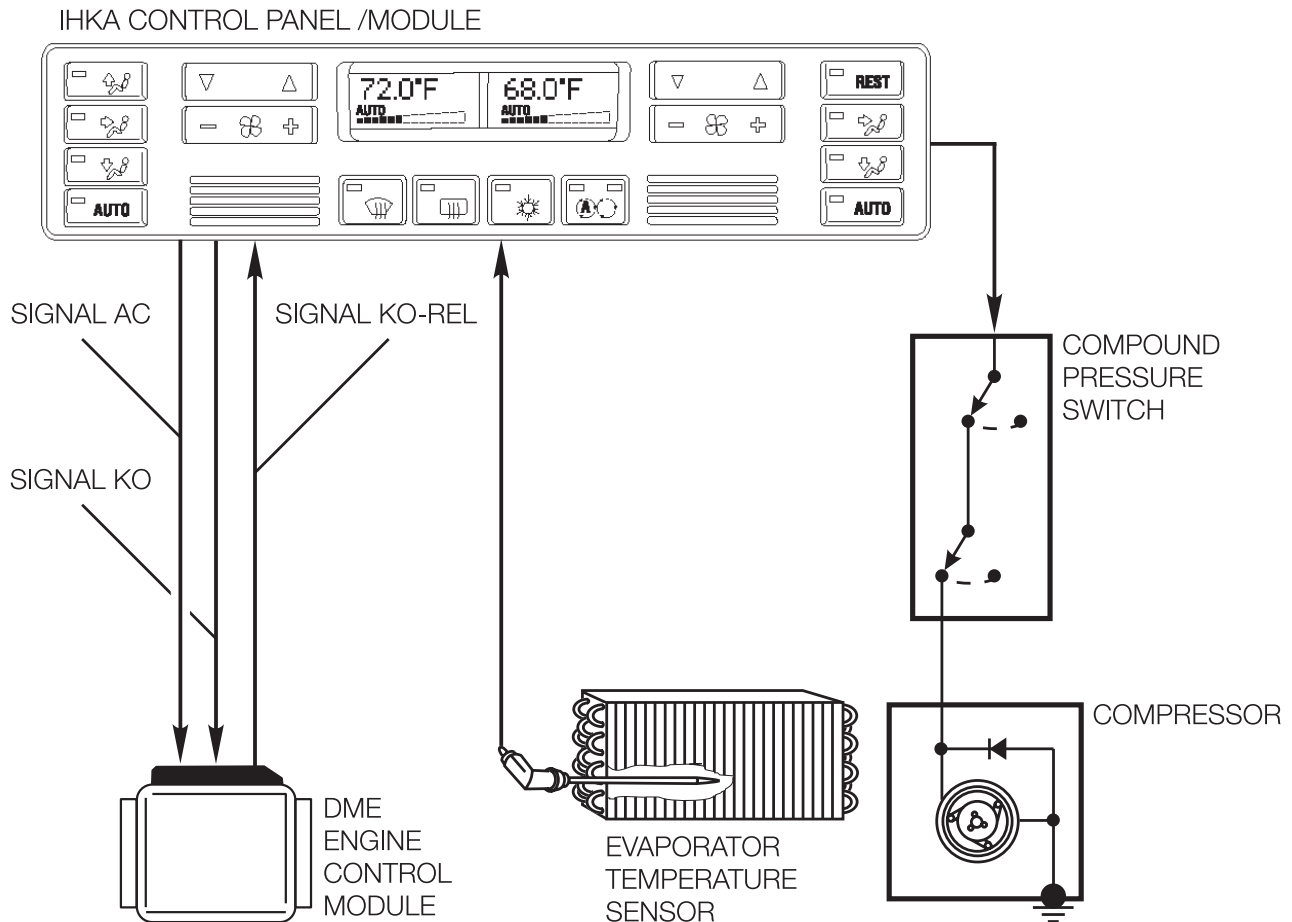


E38 Console Thumbwheel Controls

- The housing assembly design allows a single stepper motor/flap assembly to provide both open/close operation and temperature mixing.



IHKA E38 COMPRESSOR CONTROL



IHKA E38 compressor control is significantly different from that on previous IHKA systems:

- The engine control module (ECM) and the IHKA control panel/module communicate via three direct circuits; there are no relays.
- The IHKA control panel/module powers the A/C compressor clutch coil directly; again, there is no relay.

When the “snowflake” button is pressed, the control panel/module signals the ECM that engine load is about to be increased (signal AC). The ECM **immediately** boosts engine idle speed by 100 to 200 RPM, **regardless of A/C compressor clutch status**.

- Signal AC is continuously active (high) while the “snowflake” button LED is illuminated.

If evaporator temperature is above 37°F (3°C), the control panel/module then signals the ECM that it is about to engage the A/C compressor (signal KO). So long as the ECM does not signal back (signal KO-REL) that A/C compressor operation is not allowed, the control panel/module engages the compressor.

- Signal KO cycles high and low as the IHKA control panel/module monitors evaporator temperature and cycles the compressor on and off.

If the ECM detects “full-load” conditions, it sends signal KO REL to the IHKA control panel/module to disengage the A/C compressor. The conditions for full load are:

- Vehicle speed is less than 10 mph, **and**
- Throttle is wide open **or**
- Engine coolant temperature is too high

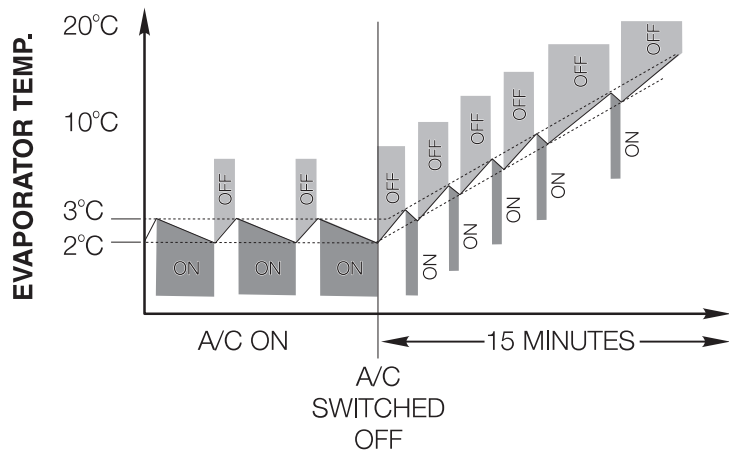
The compressor is turned off for a **maximum** of 4 minutes.

As on previous IHKA systems, refrigerant pressure switches can interrupt compressor operation, but cutout pressures are slightly higher on the E38 system:

- The high-pressure switch opens if refrigerant pressure exceeds **479 psi (33 bar)**, and closes if pressure then drops to **334 psi (23 bar)**.
- The low-pressure switch (still on the high side of the system) opens if pressure drops below **28 psi (1.9 bar)**, and closes if pressure rises to **41 psi (2.8 bar)**.

IHKA E38 includes several additional compressor control strategies:

- If the “snowflake” button is on at engine start-up, the control panel/module delays compressor clutch activation until engine speed exceeds 600 RPM for at least 5 seconds.
- As on E31 vehicles, if the driver switches “Off” the A/C compressor while the vehicle is moving, the control panel/module continues to cycle the compressor on and off (for increasingly longer “off” times) for up to 15 minutes. This allows the evaporator to warm up gradually, helping to prevent windshield fogging. If the evaporator reaches ambient temperature in less than 15 minutes, the compressor is shut off sooner.



A/C Compressor Timed Shut Down

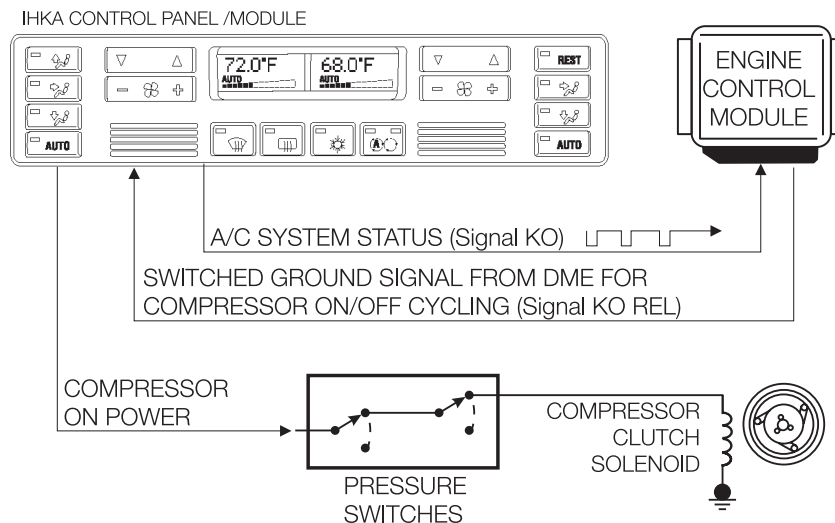
- A unique E38 feature is ambient temperature compensation. When ambient temperature exceeds 68°F (20°C), the control panel/module activates the compressor at an evaporator temperature above 33°F (1°C), instead of 37°F (3°C). This provides additional cooling.

A/C COMPRESSOR CONTROL

(5/97 and later 740, 9/97 and later 750)

Activation of the compressor clutch is an output control function of the IHKA module. Activation is carried out directly through a final stage in the module (no relay required).

The signals KO and AC have been combined into one signal providing multiple data through a stepped increase in signal duty cycle.



The individual switching stages are transferred by way of pulse width modulation with a frequency of 5 Hz.

Diagnosis of the line is carried out by the ECM.

SIGNAL KOREL:

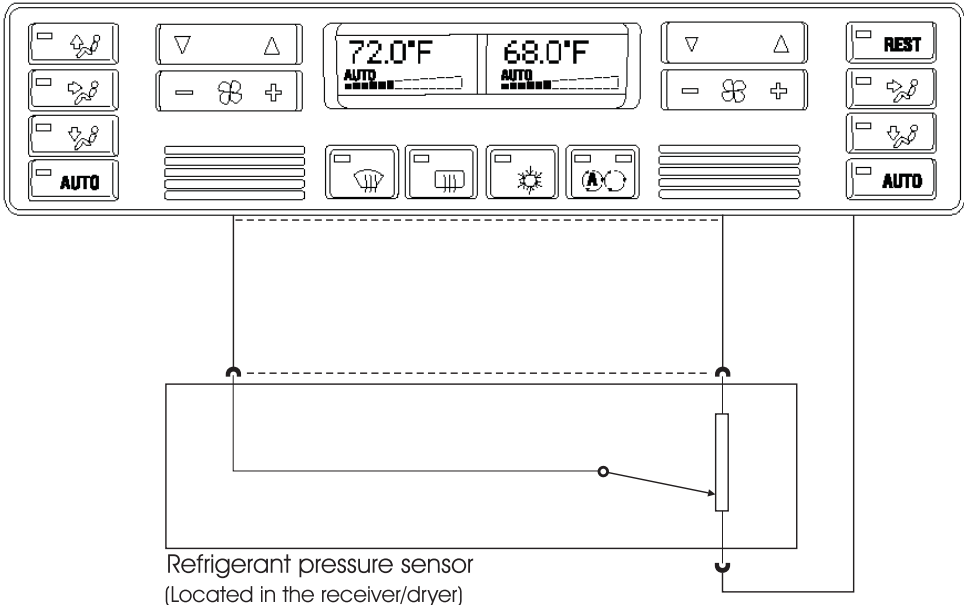
PULSE DUTY FACTOR IN %	FUNCTIONS
0	Short to U-batt. or line break
15	Air conditioning off
30	Air conditioning standby (DME-AC) ON
45	A/C compressor ON, stage 1 = 5-10 Nm
60	A/C compressor ON, stage 2 = 10-15 Nm
75	A/C compressor ON, stage 3 = 15-20 Nm
90	A/C compressor ON, stage 4 = 20-24 Nm
100	Short to ground

Anticipated Load on Compressor

The engine control module signals the IHKA (Signal KOREL) when the idle increase has taken place and the IHKA will then activate the compressor clutch, as long as all other compressor requirements are satisfied. Compressor cut off conditions include:

- Evaporator temperature below 2°C
- Coolant temperature > 117°C - causes the compressor to run in a pulsed operation.
- Coolant temperature > 120°C - the compressor clutch is deactivated until the temperature drops below 117°C
- Full acceleration at low speeds - below 10 MPH with a full throttle input will cause the compressor to shut off for 10 seconds

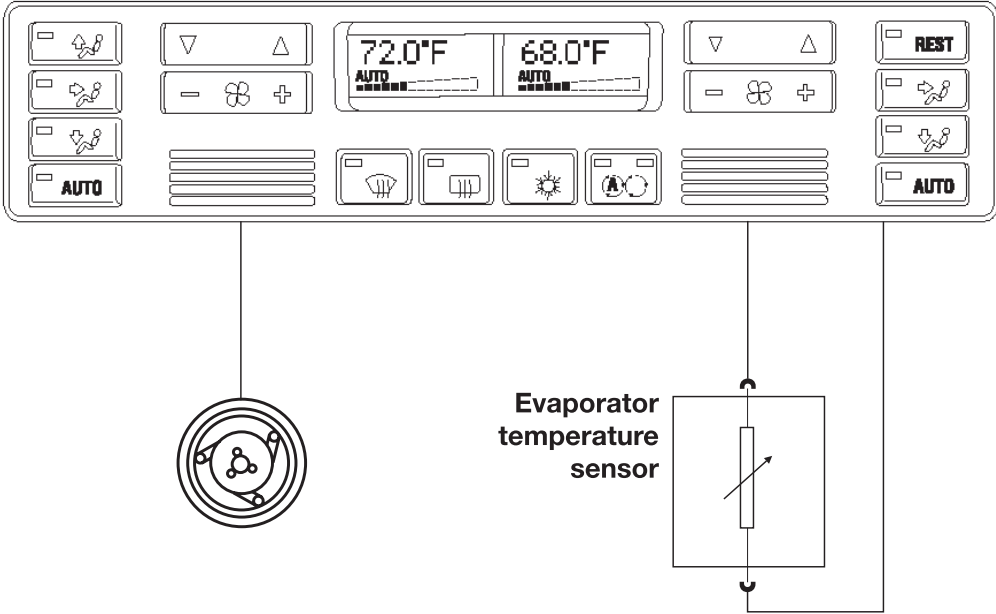
AC COMPRESSOR CONTROL '99 MODEL YEAR



For '99 Model Year, both 740iL and 750iL IHKA now receive a variable input from the refrigerant pressure “sensor”. The sensor is mounted in the receiver/dryer.

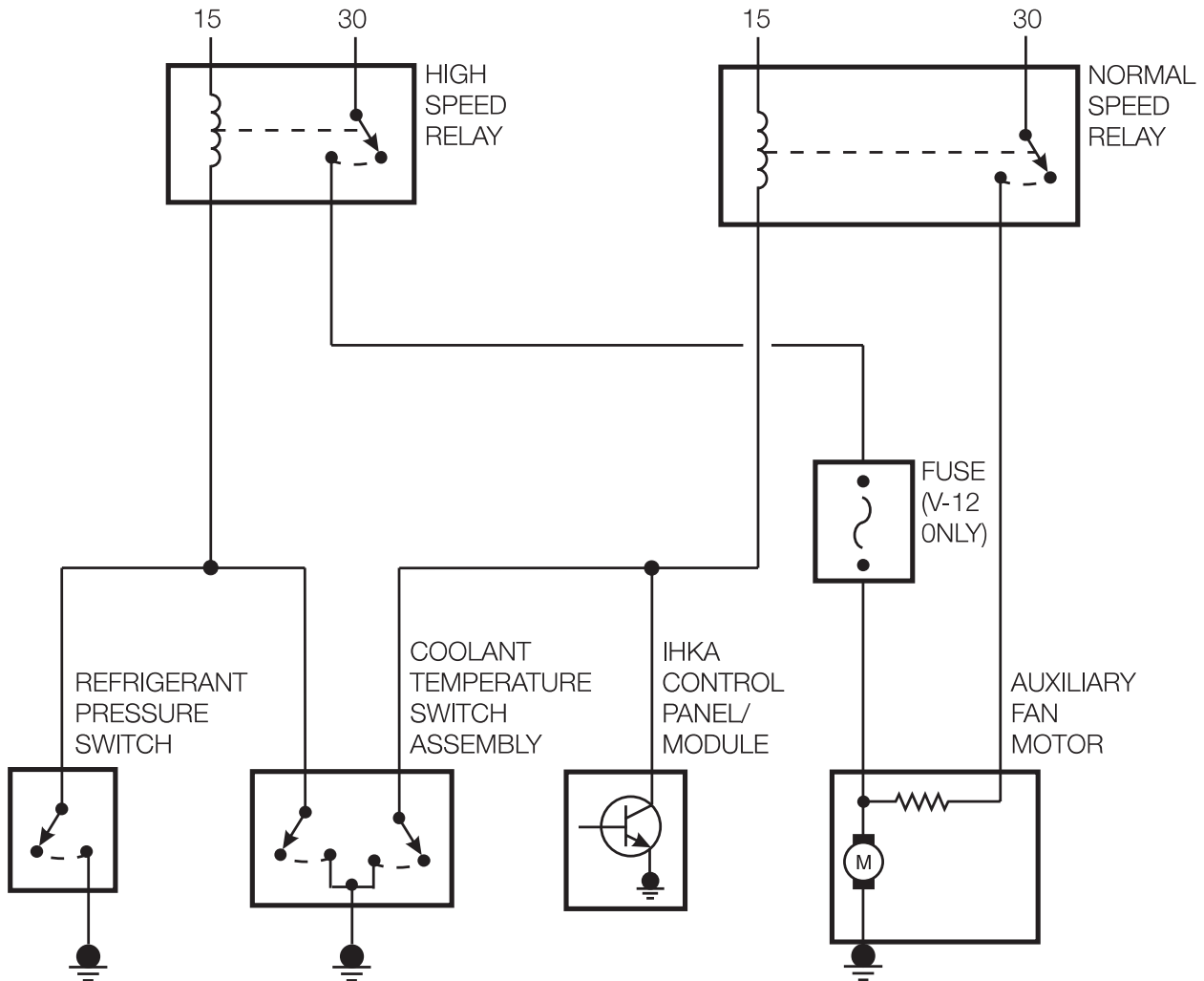
Based on the refrigerant pressure, the pressure sensor input allows the IHKA module to determine the “start up” torque of the A/C compressor. If the pressure is too low or high the compressor will be deactivated. The IHKA also anticipates the necessary auxiliary fan speed and passes this information on to the ECM via the K-bus.

This change now removes the pressure sensor from the compressor activation circuit.



IHKA E38 AUXILIARY FAN CONTROL (up to 96 MY)

The auxiliary fan on E38 vehicles is a two-speed unit, and it operates similar to the auxiliary fan on previous IHKA systems.

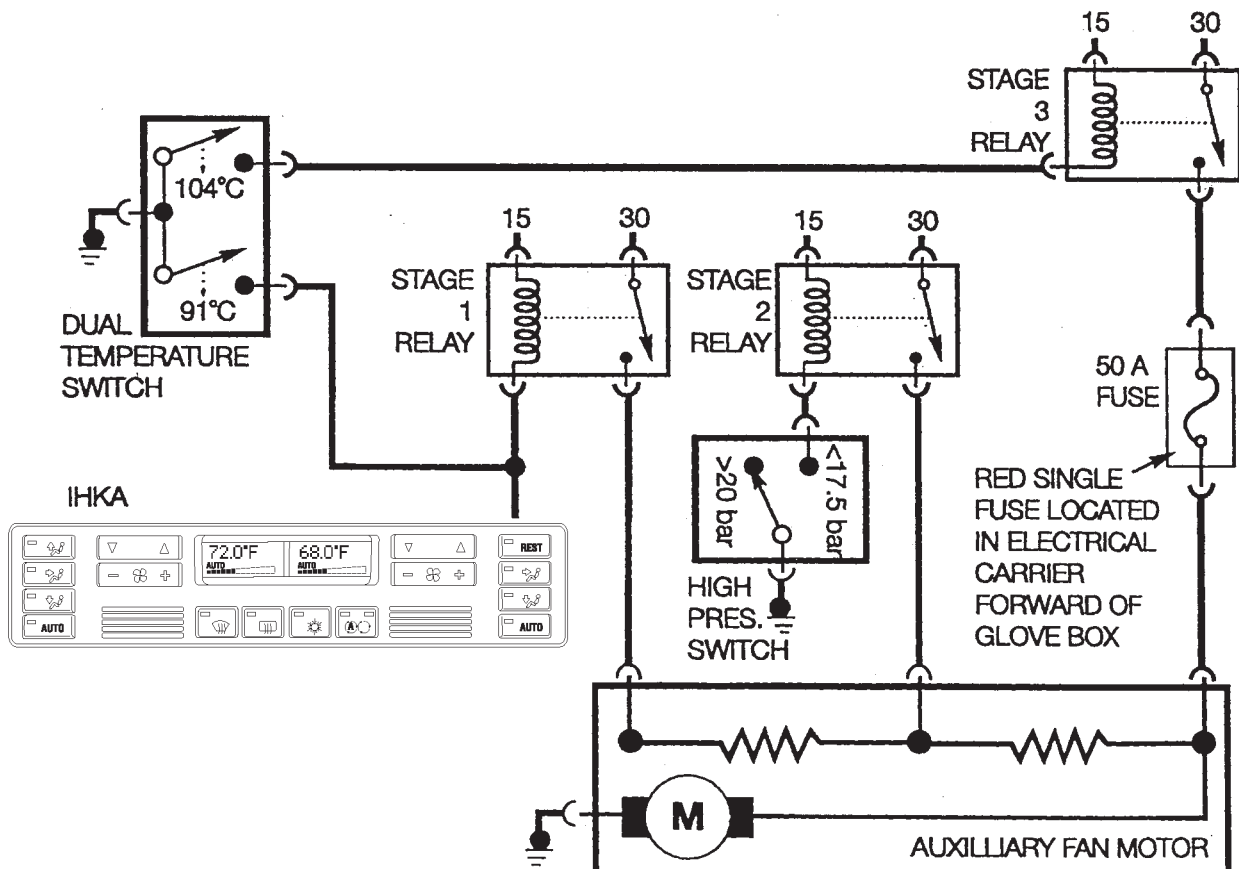


- The IHKA control panel/module energizes the normal speed relay to run the fan when the A/C compressor is operating **and ambient temperature is 50°F (10°C) or higher**.
- When refrigerant high-side pressure exceeds **290 psi (20 bar)**, the pressure switch contacts close, energizing the high speed relay. The fan runs at high speed.
- When coolant temperature reaches **196°F (91°C)**, the coolant temperature switch normal speed contacts close. The fan runs at normal speed.
- If coolant temperature continues to rise and reaches **210°F (99°C)**, the coolant temperature switch high speed contacts close. The fan runs at high speed.

AUXILIARY FAN CONTROL

The auxiliary fan is a three stage operation as introduced on the 1996 E38.

- Stage 1:** Activated simultaneously with the compressor with an ambient air temperature $>10^{\circ}\text{C}$ (50°F). If the coolant temperature rises to $>91^{\circ}\text{C}$ the fan will also be switched on. Fan Speed = 1250 RPM.
- Stage 2:** Activated when the medium pressure switch on the receiver/dryer closes at 17.5 bar. Fan Speed = 2000 RPM.
- Stage 3:** Activated when the coolant temperature reaches 104°C at the double temperature switch. The stage 3 switched voltage circuit is protected by a 50 amp remote fuse (red). The fuse is located in the electrical carrier forward of the glove box.



AUXILIARY FAN CONTROL ('99 MODEL YEAR - E38)

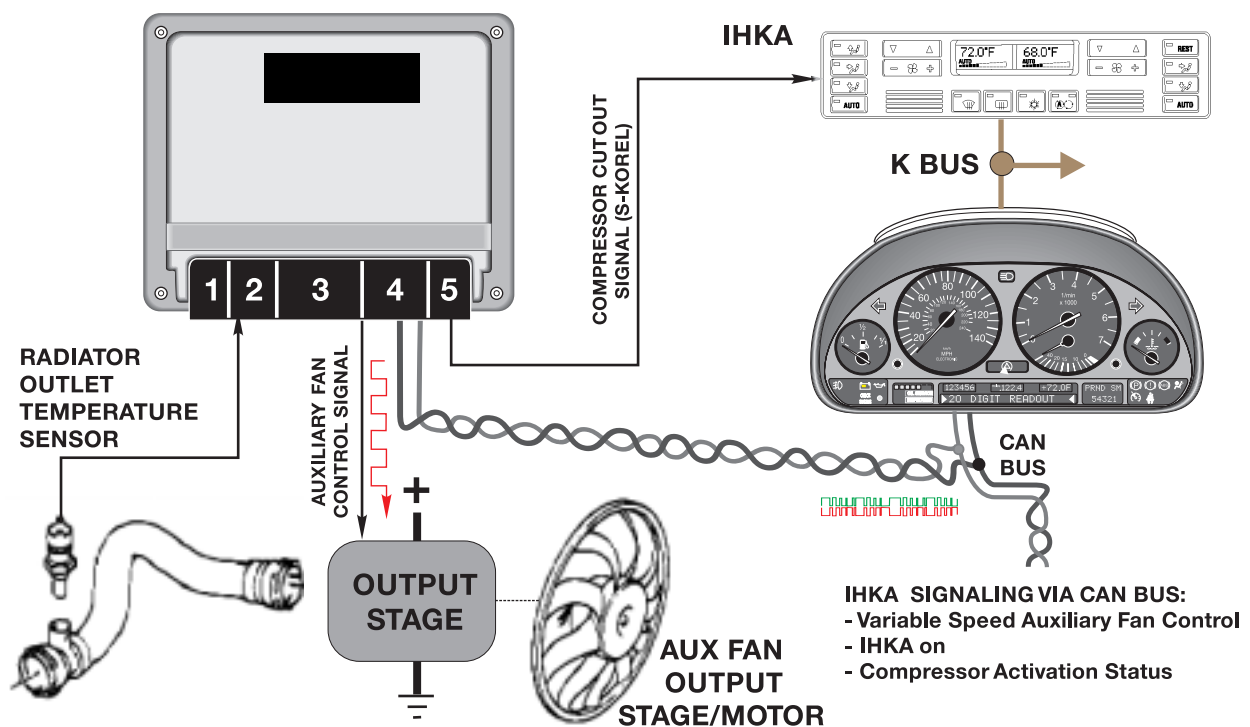
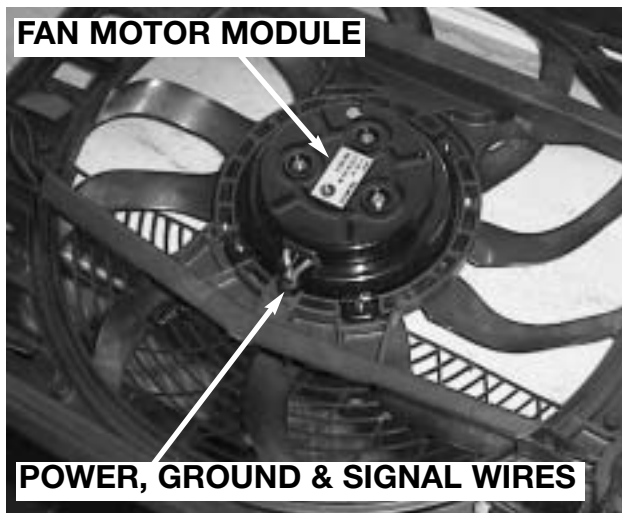
The Auxiliary Fan motor incorporates an output final stage that activates the fan motor at variable speeds.

The auxiliary fan is controlled by ME 7.2 (ECM). The motor output stage receives power and ground and activates the motor based on a PWM signal (10-100 Hz) received from the ME 7.2.

The fan is activated based on the following factors:

- Radiator outlet temperature sensor input exceeds a preset temperature.
- IHKA signalling via the K and CAN bus based on calculated refrigerant pressures.
- Vehicle speed
- Battery voltage level

When the over temperature light in the instrument cluster is on (120°C) the fan is run in the overrun function. This signal is provided to the ECM via the CAN bus. When this occurs the fan is run at a frequency of 10 Hz.



IHKA E38 REAR WINDOW DEFROSTER

On the E38, rear window defroster operating strategy depends upon whether ambient temperature is above or below 5°F (-15°C):

- If ambient temperature is **below 5°F (-15°C)**, pressing the rear window defroster button (ignition switch in “Run”), causes the control/panel module to turn on the defroster for **17 minutes**, and then switch it off.
- If ambient temperature is **above 5°F (-15°C)**, the control/panel module runs the defroster for only **10 minutes** before switching it off.

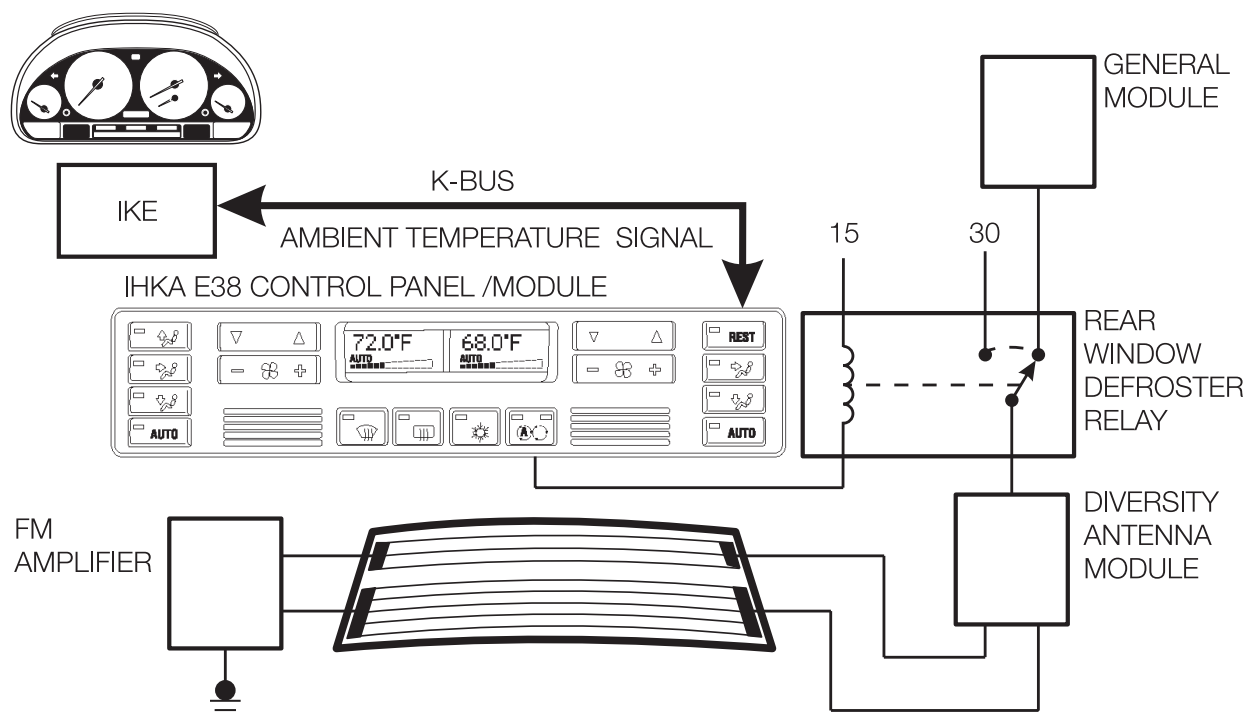
Reactivating the defroster by pressing the button again causes the defroster to run for an additional 5 minutes, regardless of ambient temperature.

If the ignition is switched “Off,” the defroster is shut off, but the timer keeps operating. If the ignition is then switched “On” again with time remaining, the defroster automatically turns “On” again until the timer runs out.

If battery voltage drops below 12.2 volts, the defroster automatically switches “Off.”

Unlike IHKA E32 systems, the rear window defroster is **not** automatically activated when maximum defrosting is requested.

* Ambient temperature is supplied to the control panel/module over the K-Bus.



E38 WINDSHIELD BASE/WASHER SPRAY JET HEATERS

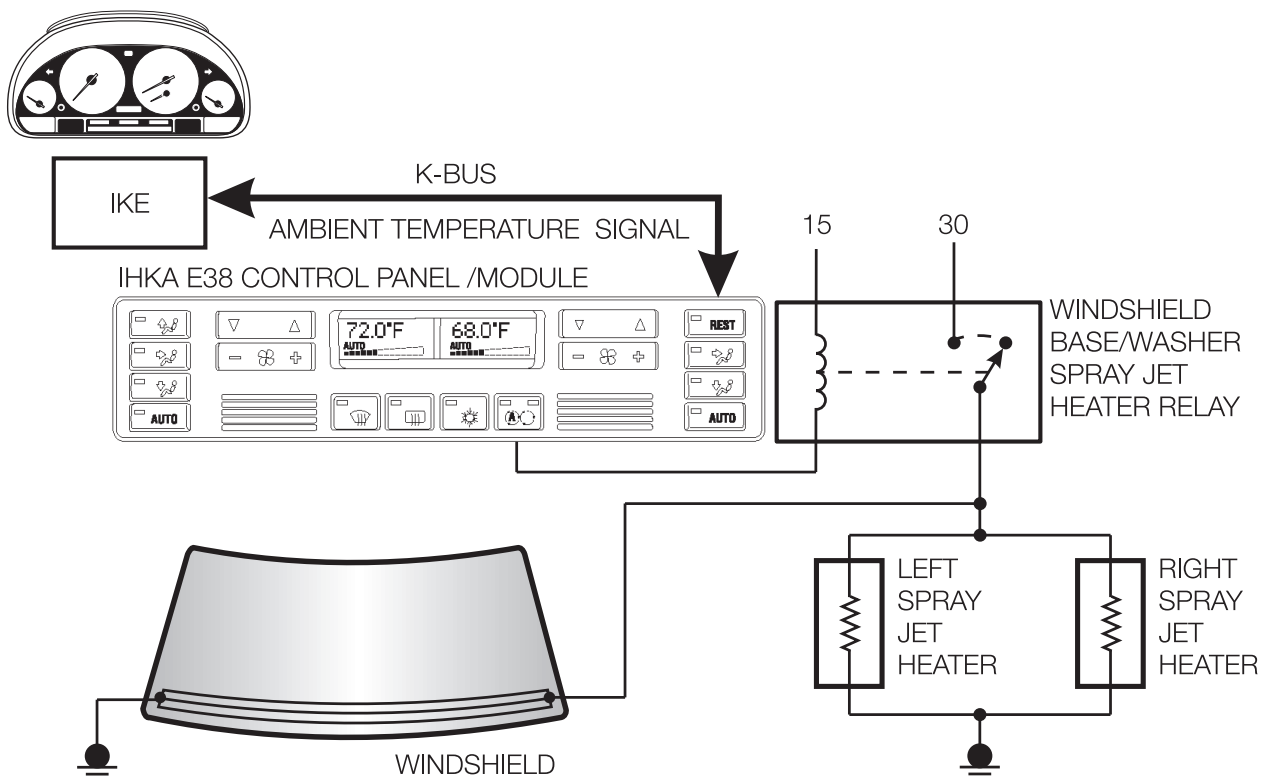
E38 vehicles are equipped with a windshield base/washer spray jet heater system similar to the one found on 1988 and 1989 E32 vehicles. On E38 vehicles, however, both heater systems are powered at the same time by the same relay:

- The lower portion of the windshield contains electrical resistance heating elements (similar to those on a heated rear window) which, when powered, prevent the wiper blades from freezing to the glass.
- The washer spray jet heaters are located on the underside of the hood and are designed to prevent ice from forming on and obstructing the washer nozzles.

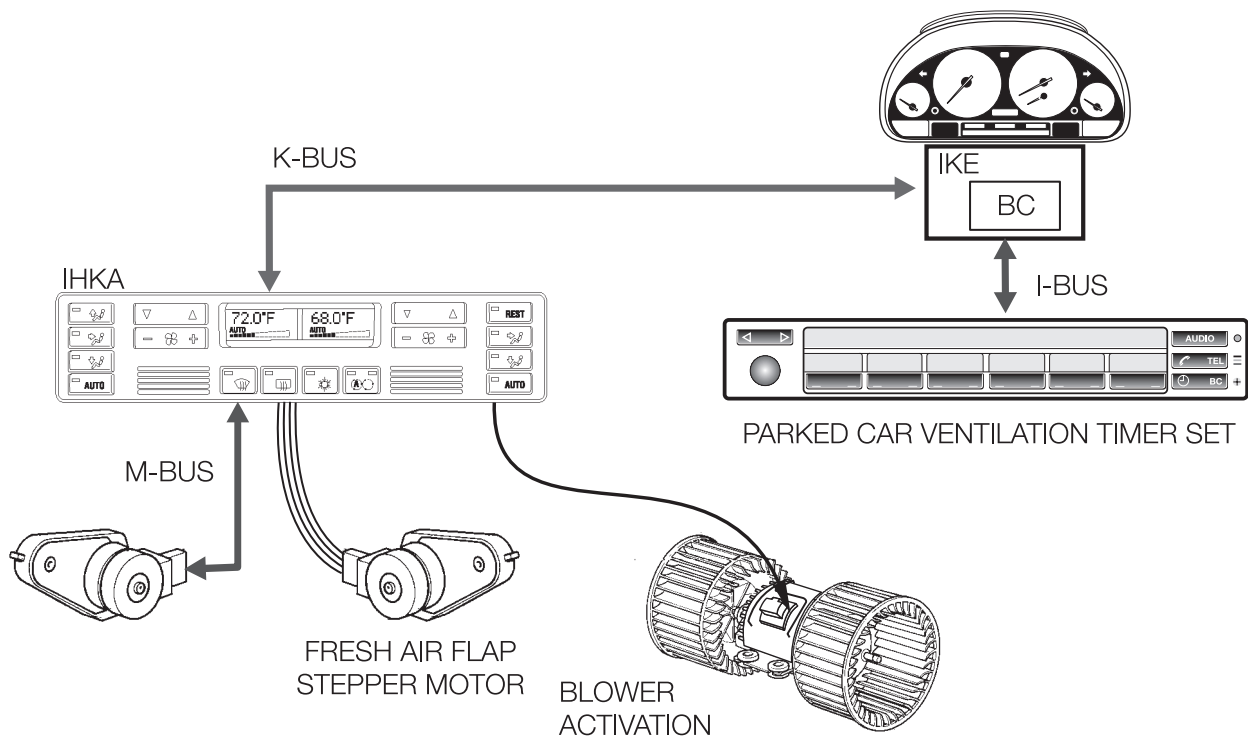
The control panel/module monitors the signal from the ambient temperature sensor (K-Bus) and automatically activates the windshield base/washer spray jet heater relay when:

- Ambient temperature is lower than 38°F (3°C), **and**
- The ignition is “on” **and**
- Battery voltage is greater than 12.2 volts.

When ambient temperature exceeds 43°F (6°C), the windshield base/washer spray jet heaters are switched off.



IHKA E38 PARKED CAR VENTILATION



On the E38, parked car ventilation operates the same way as the system on previous IHKA systems. At pre-programmed times, the IHKA control panel/module:

- opens the fresh air flaps and face vent flaps, **and**
- closes all other flaps, **and**
- runs the blower at low speed for **one-half hour**.

E38 system differences are:

- A parked car ventilation dual relay is not used on the E38 - all switching is done directly by the IHKA control panel/module.
- On the E38, desired ventilation “On” times are programmed into the IKE On-Board Computer (BC) using the Multi-Information Display (MID).
- The BC in the IKE then communicates with the IHKA control panel/module over the I-bus and K-bus.

SPECIAL FUNCTIONS

Like previous IHKA systems, the E38 IHKA system control panel/module is programmed to perform some special functions automatically based on sensed inputs:

Cold Start Arrest

IHKA E38 includes an automatically activated cold start arrest function. The control panel/module checks for the conditions necessary to activate the function at engine start-up:

- IHKA system turned “on” (left blower thumbwheel not in “0” position) **and**
- Maximum defrosting request is **not** present **and**
- Left Y-factor is 100% (maximum heating required) **and**
- Left side “AUTO” mode request is present **and**
- Left heater core temperature is less than 86°F (30°C).

If these conditions exist, the control panel/module will:

- Open the defroster flaps **and**
- Close all other air distribution flaps **and**
- Operate the blower motor, A/C compressor, fresh air flaps, and recirc. air flaps **according to control panel/module settings.**

When the left heater core temperature reaches 86°F (30°C), the cold start arrest function ends and **all** IHKA system functions depend upon control panel/module settings and sensed conditions.

Service-Station Feature

This function, introduced on IHKA E32, continues on IHKA E38. The control panel/module continues to power both coolant valves **closed** for about 3 minutes after the ignition is switched “Off.” This feature prevents the heater cores from being flooded with hot coolant when the engine is shut off for brief periods (e.g. during refueling).

“Rest” Feature

The “Rest” feature is a new feature, providing passenger compartment heating for a short time **after** the ignition is switched “Off.” The feature is activated by pressing the “Rest” button on the control panel/module, if the following conditions are met:

- Ignition switch is “Off” **and**
- The ambient temperature is less than 59°F (15°C) **and**
- The left heater core temperature is greater than 158°F (70°C) **and**
- Battery voltage is greater than 11.4 volts **and**
- The time elapsed since the ignition was turned “Off” is less than 15 minutes.

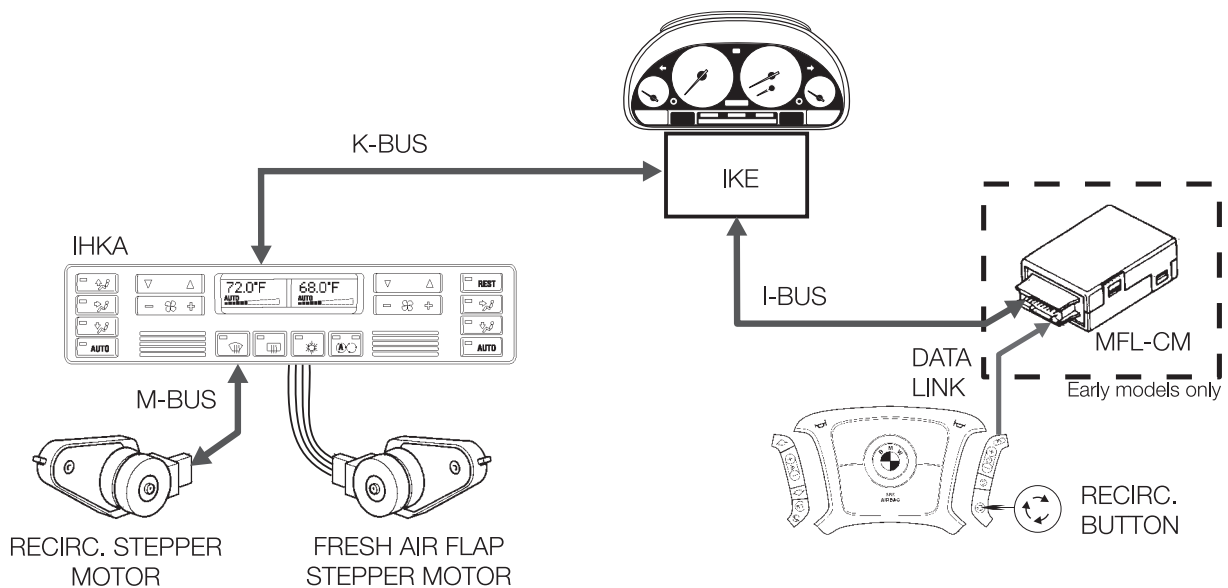
Once the function is activated, the “REST” button LED illuminates, the blower runs at medium speed, the auxiliary coolant pump runs, and the air distribution flaps are positioned to provide maximum heating. Blower speed, flaps positions, and desired temperatures **cannot be changed** while the “Rest” function is active.

The system continues to run until any **one** of the following occurs:

- The ignition is switched “On” or
- Battery voltage drops below 11.4 volts or
- Coolant temperature drops below 86°F (30°C) or
- The “Rest” button is pressed again or
- 15 minutes pass.

The “Rest” function can also be activated when the ignition switch is in the “Accessory” position (Kl.R). In “Accessory,” blower speed, desired temperature, and air distribution **can** be changed, using the control panel/module rocker switches, thumbwheels, and buttons.

Remote Recirculated Air



The E38 multi-function steering wheel contains a button which the driver can use to activate the recirculating air mode without taking his/her hands off the steering wheel.

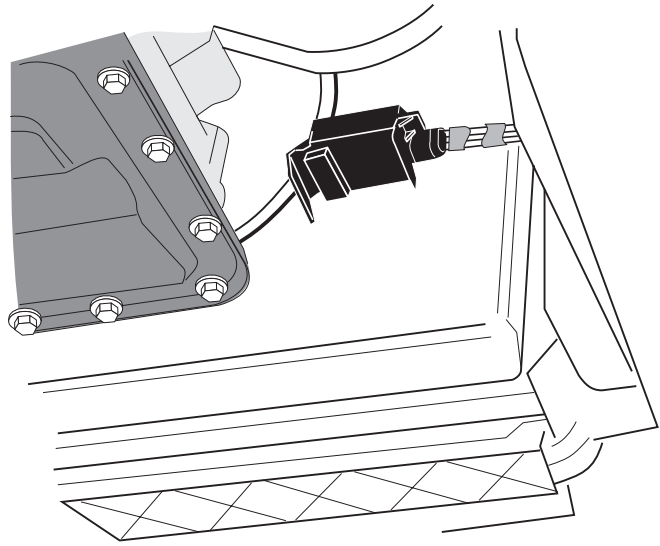
Note that almost all aspects of this function are performed using bus communication.

Automatic Recirculated Air (AUC)



If the driver presses the recirculating air button once, the control panel/module takes over control of recirculating air mode. The control panel/module uses data from the AUC sensor to determine whether recirculating air mode is necessary.

The AUC sensor, located in the lower right corner of the fan shroud, samples ambient air that has entered the engine compartment. The sensor contains a gas sensor, which measures the level of oxidizable gases in air. These include hydrocarbons, NO_x, SO_x and CO. The AUC sensor sends a voltage signal to the control panel/module according to the concentration of these pollutants.



AUC Sensor Location

If a high level of pollutants is detected, the control panel/module activates the recirculating air mode as follows:

- In **heating** mode, recirculating air is used for a maximum of **3 minutes**.
- In **cooling** mode, recirculating air is used for a maximum of **10 minutes**.

If the level of oxidizable gases drops to an acceptable point before the time limit is reached, the IHKA system switches back to fresh air intake. If air quality has not improved at the end of the time limit, the system switches to fresh air briefly and then back to recirculating mode for another 3 or 10 minute period.

IHKA PERSONALIZATION - E38

Important: Due to the variations in hardware and software, it is recommended that “Print List” is selected prior to programming. “Print List” will give an overview of the available Car and Key Memory options for that specific vehicle.

Car Memory Options Key Memory Options Programming Procedure

“Car Memory/Key Memory” is an additional step towards customization of a vehicle according to owner’s individual preferences. Those features are incorporated in ZCS Coding/Programming and the scope of customization of a vehicle.

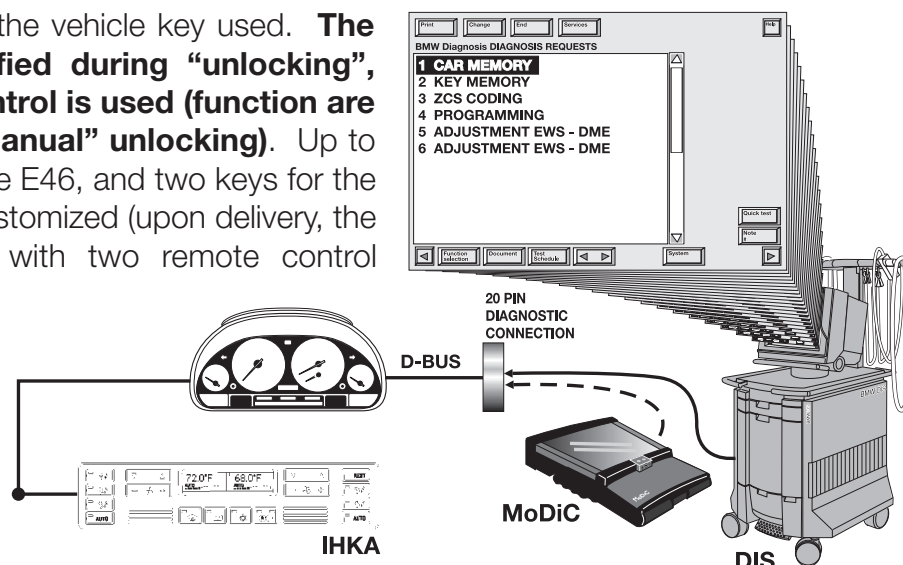
Heating/Air Conditioning/Ventilation			
Flaps			
Air recirculation memory	active =not active	Interior air is recirculated when cooling in “hot country” setting.	E38 1999 Model Year E39 1999 Model Year E38 prior to 9/98 E39 prior 9/98
Footwell closed when cooling E38 only	normal =hot country	Footwell flaps closed when cooling to allow more center vent air for maximum cold air in “hot country” setting.	E38 1999 Model Year E39 1999 Model Year E38 prior to 9/98
Defrost closed when cooling E38/E39 only	normal =hot country	Defrost vents closed to allow more center vent for maximum cold air in “hot country” setting.	E38 1999 Model Year E39 1999 Model Year E38 prior to 9/98
Ventilation when cooling	normal =hot country		E38 1999 Model Year E38 prior to 9/98
Blower			
Automatic blower speed operation E39 only	normal =hot country	More fan output during cooling when “hot country” is selected.	E39 1999 Model Year E39 prior 9/98
Air Recirculation	normal =hot country	A larger portion of cooler air is recirculated when “hot country” is selected.	E38 1999 Model Year E38 prior to 9/98
Key Selective*	=active not active	*This selection is not yet functional on the E39 but is listed.	E39 1999 Model Year

Diagnostic Software version 16.1 (DIS/MoDiC III) allows for the selection of “Car Memory” choices in E38 and E39s produced prior to 9/98 depending on the vehicle hardware/software status. “Key Memory” is **not** available for E38 and E39s produced prior to 9/98.

“Car Memory” includes functions which are activated regardless of the vehicle key being used.

“Key Memory” contains functions which can be different depending on the vehicle key used. **The vehicle key is identified during “unlocking”, only when remote control is used (function are inoperative during “manual” unlocking).** Up to four different keys for the E46, and two keys for the E38 and E39 can be customized (upon delivery, the customer is provided with two remote control transmitters).

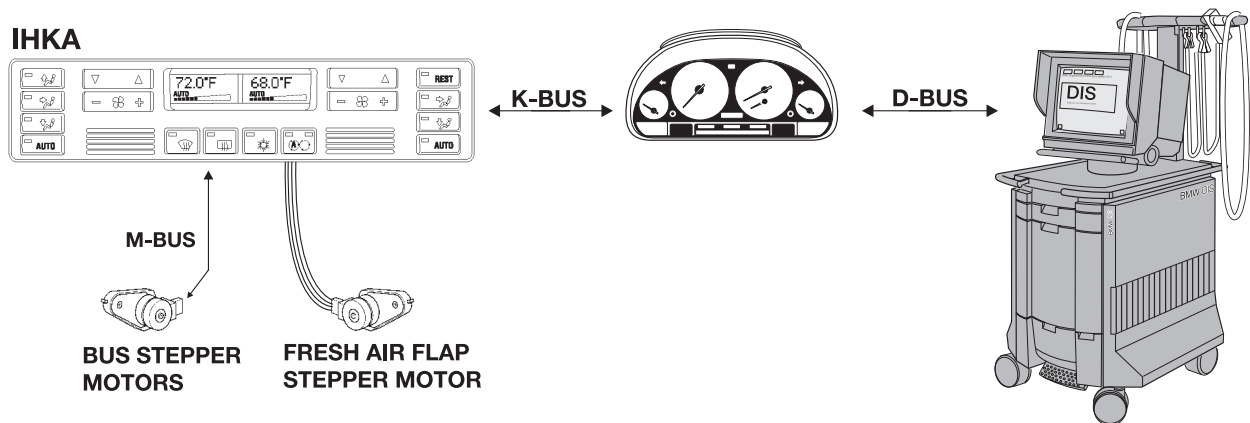
These features are programmed using the coding/programming function of the DIS/MoDiC.



DIAGNOSIS

The DIS tester and E38 software are used to troubleshoot and diagnosis the IHKA system. The following displays and test programs are available, once the tester is connected and the diagnostic program is accessed:

- Testing based on a fault symptom
- Readout and testing based on the status list displays
- Simulation of outputs
- Readout and display of stored faults
- Testing/troubleshooting based on fault displays
- Canceling of the fault memory



Replacement values are stored in the control module that will allow the IHKA system to continue to function when various sensors fail. Output faults result in the switching off of the failed output.

the fault memory is contained in a non-volatile RAM so that any stored faults will not be canceled when the system is switched off or the battery is disconnected. A maximum of six faults can be stored in the fault memory.